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Best Demonstrated Available Technology (BDAT) Background Document for Halogenated Pesticide and Chlorobenzene Wastes K032-K034, K041, K042, K085, K097, K098, K105, D012-D017

Versar, Inc., Springfield, VA

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This background document provides the Agency's technical support and rationale for the development of treatment standards for the constituents to be regulated for the above-mentioned wastes.

This section describes the industry affected by the land disposal restrictions for the halogenated pesticide and chlorobenzene wastes included in Table 1-1, the processes generating the wastes, the available characterization data, and the determination of waste treatability groups.

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FINAL

BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT)
BACKGROUND DOCUMENT
FOR
HALOGENATED PESTICIDE AND CHLOROBENZENE WASTES

K032-K034, K041, K042, K085, K097, K098, K105, D012-D017

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1.0 INTRODUCTION

1.1 Regulatory Background

Section 3004(m) of the Resource Conservation and Recovery Act (RCRA), as amended by the Hazardous and Solid Waste Amendments (HSWA) on November 8, 1984, requires the U.S. Environmental Protection Agency (EPA or the Agency) to promulgate treatment standards for certain hazardous wastes based on the Best Demonstrated Available Technology (BDAT) for these wastes. More than 500 of these hazardous wastes were listed as of December 1988 (see Title 40, Code of Federal Regulations, Part 261 (40 CFR Part 261)). The Agency divided the listed hazardous wastes into five groups to determine whether further land disposal is protective of human health and the environment (see 40 CFR Part 268). The five groups and their respective dates of promulgation of treatment standards are:

• Solvent and dioxin wastes	November 7, 1986
• "California List" wastes	July 8, 1987
• "First Third" wastes	August 8, 1988
• "Second Third" wastes	June 8, 1989
• "Third Third" wastes	On or before May 8, 1990

Several wastes included in this schedule were regulated ahead of schedule, and several wastes in the "First Third" or "Second Third" group of wastes were deferred to the "Third Third" group of wastes. Treatment standards for the "Third Third" wastes will become effective no later than May 8, 1990. On or after this date, wastes that are regulated in the "Third Third" rulemaking must comply with applicable treatment standards prior to "land disposal" as defined in 40 CFR Part 268.

The specific halogenated pesticide and chlorobenzene wastes that are the subject of this document are listed in Table 1-1 by waste code and include D and K wastes. (All tables are presented at the end of this section.) This background document provides the Agency's rationale and technical support for selecting constituents for regulation and for developing treatment standards for these wastes. This document also provides waste characterization data that serve as a basis for determining whether a variance from treatment standards may be warranted for a particular halogenated pesticide and chlorobenzene waste that is more difficult to treat than the wastes that were tested and from which treatment performance data were used to develop the treatment standards for the wastes included in this background document. The Agency's legal authority and promulgated methodology for establishing treatment standards and the petition process necessary for requesting a variance from the treatment standards are summarized in EPA's Methodology for Developing Treatment Standards (Reference 2).

A D-pesticide waste is a waste from a non-specific source that exhibits any characteristics of EP Toxicity of specific pesticides as described in 40 CFR 261.24. A solid waste exhibits the characteristics of EP Toxicity if, using test methods prescribed in 40 CFR Part 261, Appendix II, or equivalent EPA-approved methods, the extract of the waste contains pesticide concentrations equal to or greater than those given in Table I of 40 CFR 261.24.

Hazardous process waste streams from specific sources are listed as K wastes. They are identified as hazardous based on the characteristics of ignitability, corrosivity, reactivity, EP toxicity, acute hazard, or toxicity, as defined in 40 CFR 261.11 and 261.20 through 261.24.

The treatment standards established for the wastes covered in this document are presented by treatability group in Tables 1-2 through 1-6. These standards are applicable to the wastes as listed as well as to any wastes generated by the management or treatment of the listed wastes. For the purpose of determining the applicability of the treatment standards, wastewaters are defined as wastes containing less than 1% (weight basis) total suspended solids[1] and less than 1% (weight basis) total organic carbon (TOC).

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[1] The term "total suspended solids" (TSS) clarifies EPA's previously used terminology of "total solids" and "filterable solids." Specifically, total suspended solids are measured by Method 209c (Total Suspended Solids Dried at 103 to 105°C in Standard Methods for the Examination of Water and Wastewater (Reference 1)).

Wastes not meeting the wastewater definition must comply with treatment standards for nonwastewaters.

1.2 Document Summary

This document provides the Agency's rationale and technical support for developing treatment standards for the wastes listed in Table 1-1. Section 2.0 presents the following waste-specific information: the approximate number and geographic distribution of facilities that may be affected by the land disposal restrictions for these wastes; the processes generating these wastes; and the available waste characterization data. The Agency estimates that there are approximately 98 facilities that may be affected by the land disposal restrictions for these wastes. The four-digit Standard Industrial Classification (SIC) codes associated with the pesticides industry are 2879 and 2869 (Pesticides and Agricultural Chemicals, Not Elsewhere Classified, and Industrial Organic Chemicals, respectively). Section 2.0 also includes EPA's rationale for combining these waste codes into five treatability groups within the subcategory of halogenated pesticide and chlorobenzene wastes. (Although certain wastes are included in the halogenated pesticide and chlorobenzene subcategory, these wastes are not necessarily pesticides as defined by the Office of Pesticides and Toxic Substances.)

EPA's rationale for identifying BDAT for the wastes included in this document is presented in Section 3.0. Section 4.0 contains or references the treatment performance data the Agency used to determine BDAT and to calculate or identify the treatment standards for the wastes included in this document.

EPA's rationale for selecting constituents for regulation is presented in Section 5.0. Due to the lack of characterization data for most D nonwastewaters, only the constituent for which the waste was listed, as specified in Table I of 40 CFR 261.24, is being regulated. For K-pesticides nonwastewaters, one or more organic constituents were selected for regulation based on available waste characterization data.

Section 6.0 includes the determination of treatment standards for the halogenated pesticide and chlorobenzene wastes. As previously mentioned, Tables 1-2 through 1-6 summarize the treatment standards for wastes in each treatability group. The units used for total concentration of organic constituents are mg/kg (parts per million on a weight-by-weight basis) for the nonwastewater forms of these wastes.

Methods of treatment are specified as the BDAT treatment standards for wastewater forms of the D wastes included in this document, and concentration-based treatment standards were developed for the K wastes and nonwastewater forms of the D wastes included in this document. Treatment performance data were not available for the K wastes and the nonwastewater forms of the D wastes; therefore, the Agency transferred data from treatment of other wastes that possess chemical similarities and similar waste treatability to the given K and D wastes (as discussed in Section 4.0) to develop treatment standards.

For nonwastewater forms of the K and D wastes, BDAT treatment standards are based on incineration performance data for wastes judged to be similar. For wastewater forms of the halogenated pesticide and chlorobenzene K and D wastes, BDAT treatment standards are based on wastewater treatment performance data for wastes judged to be similar. The Agency prefers, whenever possible, to use wastewater treatment data from well-designed and well-operated wastewater treatment units rather than to base wastewater treatment standards on constituent concentrations in incinerator scrubber water. EPA has compiled a database of wastewater treatment data for use in establishing treatment standards for wastewater forms of U and P wastes and multi-source leachate. These data, compiled from a variety of sources, were transferred on a constituent-by-constituent basis for organic constituents to the halogenated pesticide and chlorobenzene K wastes.

Section 7.0 acknowledges the persons involved in preparing this document. Section 8.0 includes references cited in this document. Appendix A includes chemical structures for the constituents regulated in the D and K wastes included in this document. Appendix B summarizes treatment performance data for organic constituents in wastewater forms of halogenated pesticide and chlorobenzene D and K wastes. Appendix C includes plant codes listed in this document. Appendix D includes relevant QA/QC information corresponding to treatment performance data presented in Section 4.0. Appendix E summarizes the variability factor calculation used in the calculation of a treatment standard.

Table 1-1

WASTES INCLUDED IN THIS BACKGROUND DOCUMENT

Waste Code	Description of the Listed Waste
D012	EP Toxic for Endrin
D013	EP Toxic for Lindane
D014	EP Toxic for Methoxychlor
D015	EP Toxic for Toxaphene
D016	EP Toxic for 2,4-Dichlorophenoxyacetic acid
D017	EP toxic for 2,4,5-Trichlorophenoxypropionic acid (Silvex)
K032	Wastewater treatment sludge from the production of chlordane
K033	Wastewater and scrub water from the chlorination of cyclopentadiene in the production of chlordane
K034	Filter solids from the filtration of hexachlorocyclopentadiene in the production of chlordane
K041	Wastewater treatment sludge from the production of toxaphene
K042	Heavy ends or distillation residues from the distillation of tetrachlorobenzene in the production of 2,4,5-Trichlorophenoxyacetic acid
K085	Distillation or fractionation column bottoms from the production of chlorobenzenes
K097	Vacuum stripper discharge from the chlordane chlorinator in the production of chlordane
K098	Untreated process wastewater from the production of toxaphene
K105	Separated aqueous steam from the reactor product washing step in the production of chlorobenzenes

Table 1-2

BDAT TREATMENT STANDARDS FOR HALOGENATED PESTICIDES AND CHLOROBENZENES - GROUP 1 (CHLORINATED NORBORNANE AND NORBORNENE DERIVATIVES)

BDAT TREATMENT STANDARDS FOR K032

Regulated Constituent	Maximum for any Single Grab Sample Total Composition Nonwastewaters (mg/kg)
Hexachlorocyclopentadiene	2.4
Chlordane	0.26
Heptachlor	0.066
Heptachlor epoxide	0.066

Regulated Constituent	Maximum for any 24-hour Composite Sample Total Composition Wastewaters (mg/l)
Hexachlorocyclopentadiene	0.057
Chlordane	0.0033
Heptachlor	0.0012
Heptachlor epoxide	0.016

BDAT TREATMENT STANDARDS FOR K033

Regulated Constituent	Maximum for any Single Grab Sample Total Composition Nonwastewaters (mg/kg)
Hexachlorocyclopentadiene	2.4

Regulated Constituent	Maximum for any 24-hour Composite Sample Total Composition Wastewaters (mg/l)
Hexachlorocyclopentadiene	0.057

Table 1-2 (Continued)

BDAT TREATMENT STANDARDS FOR HALOGENATED PESTICIDES AND CHLOROBENZENES - GROUP 1 (CHLORINATED NORBORNANE AND NORBORNENE DERIVATIVES)

BDAT TREATMENT STANDARDS FOR K034

	Maximum for any Single Grab Sample Total Composition
Regulated Constituent	Nonwastewaters (mg/kg)
Hexachlorocyclopentadiene	2.4

	Maximum for any 24-hour Composite Sample Total Composition
Regulated Constituent	Wastewaters (mg/l)
Hexachlorocyclopentadiene	0.057

BDAT TREATMENT STANDARDS FOR K041

	Maximum for any Single Grab Sample Total Composition
Regulated Constituent	Nonwastewaters (mg/kg)
Toxaphene	2.6

	Maximum for any 24-hour Composite Sample Total Composition
Regulated Constituent	Wastewaters (mg/l)
Toxaphene	0.0095

Table 1-2 (Continued)

BDAT TREATMENT STANDARDS FOR HALOGENATED PESTICIDES AND CHLOROBENZENES - GROUP 1 (CHLORINATED NORBORNANE AND NORBORNENE DERIVATIVES)

BDAT TREATMENT STANDARDS FOR K097

Regulated Constituent	Maximum for any Single Grab Sample Total Composition Nonwastewaters (mg/kg)
Hexachlorocyclopentadiene	2.4
Chlordane	0.26
Heptachlor	0.066
Heptachlor epoxide	0.066

Regulated Constituent	Maximum for any 24-hour Composite Sample Total Composition Wastewaters (mg/l)
Hexachlorocyclopentadiene	0.057
Chlordane	0.0033
Heptachlor	0.0012
Heptachlor epoxide	0.016

BDAT TREATMENT STANDARDS FOR K098

Regulated Constituent	Maximum for any Single Grab Sample Total Composition Nonwastewaters (mg/kg)
Toxaphene	2.6

Regulated Constituent	Maximum for any 24-hour Composite Sample Total Composition Wastewaters (mg/l)
Toxaphene	0.0095

Table 1-2 (Continued)

BDAT TREATMENT STANDARDS FOR HALOGENATED PESTICIDES
AND CHLOROBENZENES - GROUP 1 (CHLORINATED NORBORNANE AND NORBORNENE DERIVATIVES)

BDAT TREATMENT STANDARDS FOR D012 NONWASTEWATERS

	Maximum for any Single Grab Sample Total Composition
Regulated Constituent	Nonwastewaters (mg/kg)
Endrin	0.13

BDAT TREATMENT STANDARDS FOR D012 WASTEWATERS

INCINERATION OR BIOLOGICAL TREATMENT AS A METHOD OF TREATMENT

BDAT TREATMENT STANDARDS FOR D015 NONWASTEWATERS

	Maximum for any Single Grab Sample Total Composition
Regulated Constituent	Nonwastewaters (mg/kg)
Toxaphene	1.3

BDAT TREATMENT STANDARDS FOR D015 WASTEWATERS

INCINERATION OR BIOLOGICAL TREATMENT AS A METHOD OF TREATMENT

Table 1-3

BDAT TREATMENT STANDARDS FOR HALOGENATED PESTICIDES AND CHLOROBENZENES - GROUP 2 (CHLOROBENZENES)

BDAT TREATMENT STANDARDS FOR K042

Regulated Constituent	Maximum for any Single Grab Sample Total Composition Nonwastewaters (mg/kg)
o-Dichlorobenzene	4.4
p-Dichlorobenzene	4.4
Pentachlorobenzene	4.4
1,2,4-Trichlorobenzene	4.4
1,2,4,5-Tetrachlorobenzene	4.4

Regulated Constituent	Maximum for any 24-hour Composite Sample Total Composition Wastewaters (mg/l)
o-Dichlorobenzene	0.088
p-Dichlorobenzene	0.090
Pentachlorobenzene	0.055
1,2,4-Trichlorobenzene	0.055
1,2,4,5-Tetrachlorobenzene	0.055

Table 1-3 (Continued)

BDAT TREATMENT STANDARDS FOR HALOGENATED PESTICIDES AND CHLOROBENZENES - GROUP 2 (CHLOROBENZENES)

BDAT TREATMENT STANDARDS FOR K085

Regulated Constituent	Maximum for any Single Grab Sample Total Composition Nonwastewaters (mg/kg)
Benzene	4.4
Chlorobenzene	4.4
o-Dichlorobenzene	4.4
m-Dichlorobenzene	4.4
p-Dichlorobenzene	4.4
Pentachlorobenzene	4.4
1,2,4-Trichlorobenzene	4.4
1,2,4,5-Tetrachlorobenzene	4.4
Hexachlorobenzene	4.4
Aroclor 1016	0.92
Aroclor 1221	0.92
Aroclor 1232	0.92
Aroclor 1242	0.92
Aroclor 1248	0.92
Aroclor 1254	1.8
Aroclor 1260	1.8

Regulated Constituent	Maximum for any 24-hour Composite Sample Total Composition Wastewaters (mg/l)
Benzene	0.14
Chlorobenzene	0.057
o-Dichlorobenzene	0.088
m-Dichlorobenzene	0.036
p-Dichlorobenzene	0.090
Pentachlorobenzene	0.055
1,2,4-Trichlorobenzene	0.055
1,2,4,5-Tetrachlorobenzene	0.055
Hexachlorobenzene	0.055
Aroclor 1016	0.013
Aroclor 1221	0.014
Aroclor 1232	0.013
Aroclor 1242	0.017
Aroclor 1248	0.013
Aroclor 1254	0.014
Aroclor 1260	0.014

Table 1-3 (Continued)

BDAT TREATMENT STANDARDS FOR HALOGENATED PESTICIDES AND CHLOROBENZENES - GROUP 2 (CHLOROBENZENES)

BDAT TREATMENT STANDARDS FOR K105

Regulated Constituent	Maximum for any Single Grab Sample Total Composition Nonwastewaters (mg/kg)
Benzene	4.4
Chlorobenzene	4.4
o-Dichlorobenzene	4.4
p-Dichlorobenzene	4.4
2-Chlorophenol	4.4
Phenol	4.4
2,4,5-Trichlorophenol	4.4
2,4,6-Trichlorophenol	4.4

Regulated Constituent	Maximum for any 24-hour Composite Sample Total Composition Wastewaters (mg/l)
Benzene	0.14
Chlorobenzene	0.057
o-Dichlorobenzene	0.088
p-Dichlorobenzene	0.090
2-Chlorophenol	0.044
Phenol	0.039
2,4,5-Trichlorophenol	0.18
2,4,6-Trichlorophenol	0.035

Table 1-4

BDAT TREATMENT STANDARDS FOR HALOGENATED PESTICIDES AND CHLOROBENZENES - GROUP 3 (CHLOROPHENOXYACETIC ACIDS AND DERIVATIVES)

BDAT TREATMENT STANDARDS FOR D016 NONWASTEWATERS

Regulated Constituent	Maximum for any Single Grab Sample Total Composition Nonwastewaters (mg/kg)
2,4-Dichlorophenoxyacetic acid	10

BDAT TREATMENT STANDARDS FOR D016 WASTEWATERS

INCINERATION OR CHEMICAL OXIDATION USING CHLORINE AS AN OXIDIZING AGENT OR BIOLOGICAL TREATMENT AS A METHOD OF TREATMENT

BDAT TREATMENT STANDARDS FOR D017 NONWASTEWATERS

Regulated Constituent	Maximum for any Single Grab Sample Total Composition Nonwastewaters (mg/kg)
2,4,5-Trichlorophenoxypropionic acid	7.9

BDAT TREATMENT STANDARDS FOR D017 WASTEWATERS

INCINERATION OR CHEMICAL OXIDATION USING CHLORINE AS AN OXIDIZING AGENT AS A METHOD OF TREATMENT

Table 1-5

BDAT TREATMENT STANDARDS FOR HALOGENATED PESTICIDES AND CHLOROBENZENES - GROUP 4 (CHLORINATED DIPHENYLS)

BDAT TREATMENT STANDARDS FOR D014 NONWASTEWATERS

	Maximum for any Single Grab Sample Total Composition
Regulated Constituent	Nonwastewaters (mg/kg)
Methoxychlor	0.18

BDAT TREATMENT STANDARDS FOR D014 WASTEWATERS

INCINERATION OR WET AIR OXIDATION AS A METHOD OF TREATMENT

Table 1-6

BDAT TREATMENT STANDARDS FOR HALOGENATED PESTICIDES AND CHLOROBENZENES - GROUP 5 (CHLORINATED ALIPHATICS)

BDAT TREATMENT STANDARDS FOR D013 NONWASTEWATERS

	Maximum for any Single Grab Sample Total Composition
Regulated Constituent	Nonwastewaters (mg/kg)
gamma-BHC (Lindane)	0.066

BDAT TREATMENT STANDARDS FOR D013 WASTEWATERS

INCINERATION OR GRANULAR ACTIVATED CARBON AS A METHOD OF TREATMENT

2.0 INDUSTRY AFFECTED AND WASTE CHARACTERIZATION

This section describes the industry affected by the land disposal restrictions for the halogenated pesticide and chlorobenzene wastes included in Table 1-1, the processes generating the wastes, the available characterization data, and the determination of waste treatability groups.

2.1 Industry Affected and Process Description

Facilities that generate the wastes listed in Table 1-1 include pesticide manufacturers, formulators, and packagers; agricultural experiment stations; chemical manufacturers; universities; military compounds; and treatment facilities throughout the United States. The Agency estimates that there are approximately 98 facilities that may generate these wastes. Table 2-1 lists by state and by EPA region the number of facilities that are known to currently manufacture, formulate, or package the waste constituents included in this document and that may generate these wastes. (All tables are presented at the end of this section.) Table 2-2 lists the total number of facilities that may generate each waste.

2.1.1 K Wastes

K032, K033, K034, and K097 are generated during the production of chlordane. K041 and K098 are generated during the production of toxaphene. K042 is generated during the production of 2,4,5-T, and K085 and K105 are generated during the production of chlorobenzenes.

K032, K033, K034, and K097

A generic flow diagram illustrating the chlordane manufacturing process that generates K032, K033, K034, and K097 is presented in Figure 2-1. (All figures are presented at the end of this section.) As shown in Figure 2-1, cyclopentadiene is chlorinated to obtain hexachlorocyclopentadiene. The reaction products then pass through a decanter and filter for purification, before reaching a second reaction vessel. Hexachlorocyclopentadiene is then reacted with cyclopentadiene via the Diels Alder reaction to form chlordene. The chlordene is then chlorinated to form chlordane.

K033 is comprised of the water from the primary chlorinator unit and the decanter, along with the scrubber water from the primary chlorinator unit. The water and scrubber water are sent to wastewater treatment. Wastewater treatment sludge forms the listed waste K032. Filter solids generated from the hexachlorocyclopentadiene filtration step are the listed waste K034. The reaction by-products from the secondary chlorinator are vented to a vacuum stripper. The vacuum stripper discharges are the listed waste K097.

K041 and K098

A generic flow diagram illustrating the toxaphene manufacturing process that generates K041 and K098 is presented in Figure 2-2. As shown in Figure 2-2, α-pinene is reacted with a catalyst to form camphene, which is then chlorinated to form a toxaphene solution. This solution is then stripped to yield purified toxaphene product. Waste hydrochloric acid gas from the chlorinator passes through a water absorber, scrubber, and neutralizer, and the resulting hydrochloric acid is recovered, or is neutralized and sent to wastewater treatment.

Wastewater is generated from the toxaphene production process from leaks, spills, and washdowns, as well as from the scrubbing of vent gases in the hydrochloric acid absorption and recovery step. This wastewater is the listed waste K098. Wastewater treatment sludge is generated from the addition of diatomaceous earth and lime to the wastewater; these materials act as sorption agents for the removal of toxaphene from the wastewater. This wastewater treatment sludge is the listed waste K041.

K042

A generic flow diagram illustrating the 2,4,5-T manufacturing process that generates K042 is presented in Figure 2-3. As shown in Figure 2-3, chlorobenzene is reacted with chlorine to form tetrachlorobenzene and other polychlorinated benzenes. Tetrachlorobenzene is separated from the product stream and is purified via distillation. The purified tetrachlorobenzene is then hydrolyzed to form 2,4,5-trichlorophenol. The 2,4,5-trichlorophenol is esterified to form 2,4,5-trichlorophenoxyacetic acid (2,4,5-T).

The heavy ends or residues from distillation of tetrachlorobenzene are the listed waste K042 and are expected to contain all of the chlorobenzene chlorination by-products.

K085 and K105

Chlorobenzenes are generally produced by both batch and continuous processes by chlorinating benzene in the presence of a Friedel-Crafts catalyst (such as ferric chloride), as illustrated in Figure 2-4. Because higher chlorinated benzenes are also formed as a result of the direct chlorination of benzene, chlorobenzene production is a multi-product operation (i.e., a variety of chlorinated benzenes are produced). Product ratios are influenced by temperature, mole ratios of the feed stocks, residence time, and use of catalysts. In a continuous process, the crude reaction product may be recycled to the process to achieve the desired mixture of final products. In a batch process, the desired product mixture is obtained by adjusting the chlorine concentration and the reaction temperature. Chlorobenzene products are then purified by fractional distillation and/or crystallization.

Continuous chlorination processes are generally used to minimize the quantity of higher chlorinated benzenes produced. The product mixture is separated in a fractionating column, where monochlorobenzene is recovered. The high-boiling bottom products (mostly dichlorobenzenes) are continuously removed to a second fractionating column for recovery of the di- and trichlorobenzenes. The bottoms from the two fractionating columns are the listed waste K085.

Batch processes generally include additional distillation steps to separate the higher chlorinated benzenes. Distillation bottoms from these purification steps are also the listed waste K085.

In batch production of the chlorobenzenes, the chlorobenzene products are washed in an agitated reactor with a 10% sodium hydroxide solution. The resulting separated aqueous layer is the listed waste K105.

2.1.2 D Wastes

Wastes exhibiting the characteristic of EP Toxicity are listed as D wastes. Waste codes D012, D013, D014, D015, D016, and D017 are included in this document. These wastes may be generated in a variety of ways by pesticide manufacturing processes. The EP Toxic constituents in the wastes are listed below. Concentrations of the constituents of concern may range from the values listed below to nearly pure product:

Waste Code	Constituent (Concentration in EP Leachate)
D012	Endrin (≥0.02 mg/l)
D013	Lindane (≥0.4 mg/l)
D014	Methoxychlor (≥10.0 mg/l)
D015	Toxaphene (≥0.5 mg/l)
D016	2,4-D (≥10.0 mg/l)
D017	2,4,5-TP (Silvex) (≥1.0 mg/l)

2.2 Waste Characterization

Table 2-3 summarizes the available characterization data for K032, K033, K034, K041, K042, K085, K097, K098, and K105. These data were obtained from an EPA report which summarizes waste characterization data (Reference 6).

Due to the nonspecific waste code listings for D wastes and the variability in the physical form and composition of the wastes, characterization of these wastes as a group is impractical. The constituents of concern may be present in the untreated wastes at concentrations varying from several parts per million to nearly 100 percent. D014 and D016 data were obtained from sampling and analysis conducted by EPA's Office of Solid Waste as part of the Land Disposal Restrictions Program (Reference 7). Characterization data for D014 and D016 are presented in Table 2-4.

2.3 Determination of Waste Treatability Groups

The wastes included in this document were combined into treatability groups based on similarities in elemental composition, on functional groups present within the structure of the chemical, and on physical and chemical properties, such as volatility and bond dissociation energy, known to affect the selection of treatment alternatives and the performance of the technology. The wastes were first categorized as halogenated pesticides and chlorobenzenes based on general chemical structure. These wastes were then combined into five waste treatability groups as described below. Chemical structures for wastes included in each treatability group are shown in Appendix A.

2.3.1 Group 1 - Chlorinated Norbornane and Norbornene Derivatives

The waste codes included in group 1 represent compounds that are classified as chlorinated norbornane or norbornene derivatives. These compounds contain two fused or bridged rings, one of which is a six-membered ring. These compounds have common functional groups of single and double carbon-carbon bonds. The compounds in this group also have several substituents attached to their rings, mainly methyl groups and chlorine atoms. Based on these similarities in elemental composition and functional groups, the waste codes listed below were grouped together:

K032	Listed for Hexachlorocyclopentadiene
K033	Listed for Hexachlorocyclopentadiene
K034	Listed for Hexachlorocyclopentadiene
K041	Listed for Toxaphene
K097	Listed for Chlordane and Heptachlor
K098	Listed for Toxaphene
D012	Endrin (≥0.2 mg/l in the EP extract)
D015	Toxaphene (≥0.5 mg/l in the EP extract)

2.3.2 Group 2 - Chlorobenzenes

The waste codes included in group 2 represent compounds that are classified as chlorinated benzenes. The functional group common to all of the compounds in this group is an aromatic ring. In addition, all of these compounds (with the exception of benzene) have at least one chlorine atom included in their structure. Based on these similarities in elemental composition and functional group, the waste codes listed below were grouped together:

K042	Listed for Hexachlorobenzene and o-Dichlorobenzene
K085	Listed for Benzene, Dichlorobenzenes, Trichlorobenzenes, Tetrachlorobenzenes, Pentachlorobenzene, Hexachlorobenzene, and Benzyl Chloride
K105	Listed for Benzene, Monochlorobenzene, Dichlorobenzenes, and 2,4,6-Trichlorophenol

2.3.3 Group 3 - Chlorophenoxy Carboxylic Acids and Derivatives

The waste codes included in group 3 represent compounds that are classified as chlorophenoxy carboxylic acids. The functional groups common to all of the compounds in this group are an aromatic ring, a carbon-oxygen-carbon single bond system, a carbon-oxygen double bond, and a carbon-oxygen-hydrogen single bond system. In addition, all of these compounds have at least two chlorine atoms attached to the aromatic ring. Based on these similarities in elemental composition and functional group, the waste codes listed below were grouped together:

D016	2,4-D (≥10.0 mg/l in the EP extract)
D017	2,4,5-TP (Silvex) (≥1.0 mg/l in the EP extract)

2.3.4 Group 4 - Chlorinated Diphenyls

The waste code included in group 4, D014 - Methoxychlor (≥10.0 mg/l in the EP extract), represents compounds that are classified as diphenyls. These compounds consist of two aromatic rings that are singly bonded to a common carbon atom.

2.3.5 Group 5 - Chlorinated Aliphatics

The waste code included in group 5, D013 - Lindane (≥0.4 mg/l in the EP extract), represents compounds that are classified as chlorinated aliphatics. These compounds consist of carbon atoms joined by single and double bonds. In addition, compounds of this classification have at least one chlorine atom included in their structure.

Table 2-1

NUMBER OF FACILITIES THAT MAY GENERATE HALOGENATED PESTICIDE AND CHLOROBENZENE WASTES, BY STATE AND EPA REGION

State	EPA Region	Waste Potentially Generated (No. of Facilities)[a]
Alabama	IV	D013 (1)
Alaska	X	D013 (1), D016 (1), D017 (1)
Arizona	IX	D012 (1), D013 (1), D014 (1)
Arkansas	VI	D016 (1)
California	IX	D013 (3), D014 (2), D015 (1), D016 (3), D017 (1)
Delaware	III	K105 (1), D013 (1), D014 (1), D016 (1)
Florida	IV	D013 (1)
Georgia	IV	D013 (1)
Hawaii	IX	D014 (1)
Illinois	V	K032 (1), K033 (1), K034 (1), K097 (2), D012 (1), D014 (2), D015 (1), D016 (2)
Iowa	VII	D014 (1), D016 (2)
Louisiana	VI	D014 (2)
Massachusetts	I	D012 (1)
Michigan	V	D016 (1)
Minnesota	V	D014 (1)
Mississippi	IV	D016 (1)
Missouri	VII	D013 (1), D014 (1), D015 (1), D016 (1)

[a] Sources:
(1) U.S. EPA, 1986 TSDR Survey (Reference 3).
(2) 1987, 1988 SRI Directory of Chemical Producers, USA (References 4, 5).
(3) Telephone survey conducted in March 1989 by EPA (Reference 23).

Table 2-1 (Continued)

NUMBER OF FACILITIES THAT MAY GENERATE HALOGENATED PESTICIDE AND CHLOROBENZENE WASTES, BY STATE AND EPA REGION

State	EPA Region	Waste Potentially Generated (No. of Facilities)[a]
Nevada	IX	D013 (1), D015 (1)
New Hampshire	I	D013 (1)
New Jersey	II	K085 (1), D016 (1)
North Carolina	IV	D015 (2), D016 (1)
Ohio	V	K085 (1), D012 (2), D013 (1), D014 (1), D016 (3), D017 (1)
Pennsylvania	III	D014 (1), D016 (4)
South Carolina	IV	D012 (1)
Tennessee	IV	D012 (1)
Texas	VI	D012 (1), D013 (2), D014 (2), D015 (2), D016 (2), D017 (1)
Virginia	III	D014 (1)
West Virginia	III	K105 (1), D013 (1), D014 (1)
Wisconsin	V	D012 (1), D013 (2), D014 (1), D015 (1), D016 (1), D017 (2)

[a] Sources:
(1) U.S. EPA, 1986 TSDR Survey (Reference 3).
(2) 1987, 1988 SRI Directory of Chemical Producers, USA (References 4 and 5).
(3) Telephone survey conducted in March 1989 by EPA (Reference 23).

Table 2-2

NUMBER OF FACILITIES THAT MAY GENERATE HALOGENATED PESTICIDE AND CHLOROBENZENE WASTES, BY WASTE CODE

Waste Code	Number of Facilities[a]
D012	9
D013	18
D014	19
D015	9
D016	25
D017	6
K032	1
K033	1
K034	1
K085	2
K097	2
K105	2

[a] Sources: U.S. EPA, 1986 TSDR Survey (Reference 3).
1987, 1988 SRI Directory of Chemical Producers, USA (References 4 and 5).
Telephone survey conducted in March 1989 by EPA (Reference 23).

Table 2-3

SUMMARY OF AVAILABLE CHARACTERIZATION DATA FOR K032, K033, K034, K041, K042, K085, K097, K098, AND K105

Constituent	Concentration in Untreated Waste (%)*								
	K032	K033	K034	K041	K042	K085	K097	K098	K105
BDAT List Constituent									
4. Benzene	--	--	--	--	--	Trace-1.0	--	--	0.18
9. Chlorobenzene	--	--	--	--	--	0.1-50	--	--	0.008
78. 2-Chlorophenol	--	--	--	--	--	--	--	--	E
87. o-Dichlorobenzene	--	--	--	--	10	--	--	--	0.05
88. p-Dichlorobenzene	--	--	--	--	35	--	--	--	0.05
86-88. Dichlorobenzenes	--	--	--	--	--	1.0-50	--	--	--
110. Hexachlorobenzene	--	--	--	--	--	E	--	--	--
112. Hexachlorocyclo-pentadiene	5-75	E	5-25	--	--	--	E	--	--
136. Pentachlorobenzene	--	--	--	--	25	E	--	--	--
142. Phenols	--	--	--	--	--	--	--	--	E
148. Tetrachlorobenzene	--	--	--	--	E	0.01-10	--	--	--
150. Trichlorobenzene	--	--	--	--	20	1.0-10	--	--	--
151-152. Trichlorophenols	--	--	--	--	--	--	--	--	E
177. Chlordane	E	--	--	--	--	--	E	--	--
186. Heptachlor	E	--	--	--	--	--	E	--	--
191. Toxaphene	--	--	--	1.0	--	--	--	E	--
200-206. PCBs	--	--	--	--	--	0.01-0.1	--	--	--
Other Constituent									
Camphene	--	--	--	E	--	--	--	E	--
Caustic	--	--	--	--	--	--	--	--	0.4-0.7
Chlorinated hydrocarbons (not otherwise stated)	--	--	--	--	--	--	--	--	0.3-0.8
Chlorobenzophenones	--	--	--	--	--	0.01-0.1	--	--	--
Chlorotoluenes	--	--	--	--	--	E	--	--	--
Diatomaceous earth	--	--	--	E	--	--	--	--	--
Hex filtration media	--	--	50-90	--	--	--	--	--	--
Lime	--	--	--	E	--	--	--	--	--
Other organics	0-10	0-2	--	--	10	--	0-2	--	--
Pinene	--	--	--	E	--	--	--	--	--
-Pinene	--	--	--	--	--	--	--	E	--
Salts	0-10	--	--	--	--	--	--	--	--

-- Not analyzed for this constituent.
E Expected to be present in the waste; however, no quantitative data are available.
*Source: U.S. EPA. Characterization of Waste Streams Listed in 40 CFR Section 261 Waste Profiles (Reference 6).

Table 2-3 (Continued)

SUMMARY OF AVAILABLE CHARACTERIZATION DATA FOR K032, K033, K034, K041, K042, K085, K097, K098, AND K105

Constituent	Concentration in Untreated Waste (%)[a]								
	K032	K033	K034	K041	K042	K085	K097	K098	K105
Other Constituent (Cont.)									
Sodium chloride	--	0-20	--	--	--	--	0-20	--	15-20
Sodium hydroxide	--	0-20	--	--	--	--	0-20	--	--
Sodium hypochlorite	0-15	0-20	--	--	--	--	0-20	--	--
Water	25-90	50-95	--	E	--	--	50-95	E	78.5-99.712
Other Parameters									
Ash Content (%)	0-25	0-20	0-21	--	--	--	0-20	--	--
Heating Value (kJ/kg)	<6,978	--	<11,630	100	10,600	--	--	--	--
pH	8-13	>12.5	--	--	--	--	>12.5	--	11
Specific Gravity	1.3-1.6	1.0-1.2	0.6-0.7	--	1.6	1.2-1.3	1.0-1.2	--	1.12-1.15 @20°C
Total Organic Carbon (%)	10-40	<1	80-100	--	32	27-57	<1	--	Approx. 0.27
Total Organic Halogen (%)	0-30	<1	0-20	--	60	40-46	<1	--	Approx. 0.27
Viscosity (mPa-s)	--	0.9-1.1	--	--	--	14,000-23,500	0.9-1.1	--	--

-- Not analyzed for this constituent.

E Expected to be present in the waste; however, no quantitative data are available.

[a] Source: U.S. EPA. Characterization of Waste Streams Listed in 40 CFR Section 261 Waste Profiles (Reference 6).

Table 2-4

SUMMARY OF AVAILABLE CHARACTERIZATION DATA FOR D014 AND D016

BDAT List Constituent	Concentration in Untreated Waste (ppm)[a]		
	D014	D016-1[b]	D016-2[b]
Volatile Organics			
222. Acetone	0.13	0.057	3.3
7. Carbon tetrachloride	ND	ND	0.01
8. Carbon disulfide	ND	ND	0.059
43. Toluene	9	ND	ND
215-217. Xylenes (total)	ND	ND	0.011
Semivolatile Organics			
70. Bis(2-ethylhexyl)phthalate	ND	19.8	ND
92. Diethyl phthalate	4.05	ND	ND
Metals			
154. Antimony	4.5	16	12
155. Arsenic	6.1	ND	5.4
156. Barium	11	203	29
157. Beryllium	ND	0.36	0.12
158. Cadmium	ND	1.2	0.88
159. Chromium, total	5.1	237	25
160. Copper	2.1	30	383
161. Lead	1.3	11	3.1
162. Mercury	ND	0.17	1.8
163. Nickel	1.7	65	11
167. Vanadium	8.0	41	8.4
168. Zinc	5.3	102	494

ND - Not detected.

[a] Source: U.S. EPA, 1989. Final Characterization Report for Cedar Chemical, Velsicol Chemical Corp., A.H. Robins, and O.M. Scott and Sons. (Reference 7).

[b] Two types of D016 were sampled at O.M. Scott and Sons, as described in Reference 7.

Table 2-4 (Continued)

SUMMARY OF AVAILABLE CHARACTERIZATION DATA FOR D014 AND D016

BDAT List Constituent	Concentration in Untreated Waste (ppm)[a] D014	 D016-1[b]	 D016-2[b]
EP Toxicity Metals			
155. Arsenic	ND	0.061	0.04
156. Barium	0.068	0.06	0.073
158. Cadmium	ND	0.017	ND
159. Chromium, total	0.0081	0.028	0.013
162. Mercury	ND	0.0025	ND
Inorganics			
169. Cyanide	ND	ND	1.26
170. Fluoride	3.45	23.1	57.1
171. Sulfide	39.7	6.1	213
* Calcium	856	1,750	1,590
* Magnesium	391	21,600	1,910
* Potassium	3,220	32,800	4,270
* Sodium	98,400	1,120	1,180
Organochlorine Pesticides			
190. Methoxychlor	1,800	ND	ND
Phenoxyacetic Acid Herbicides			
192. 2,4-Dichlorophenoxyacetic acid	ND	17,000	23,000

ND - Not detected.

*Not a BDAT List constituent.

[a] Source: U.S. EPA, 1989. Final Characterization Report for Cedar Chemical, Velsicol Chemical Corp., A.H. Robins, and O.M. Scott and Sons. (Reference 7).

[b] Two types of D016 were sampled at O.M. Scott and Sons, as described in Reference 7.

Table 2-4 (Continued)

SUMMARY OF AVAILABLE CHARACTERIZATION DATA FOR D014 AND D016

Other Parameters (Units)	Concentration in Untreated Waste[a]		
	D014	D016-1[b]	D016-2[b]
Heating Value (Btu/lb)	1,438	3,251	3,578
Ash Content (%)	62.2	29.1	14.6
Moisture Content[c] (%)	4.0	18.7	56.5
Total Solids (%)	96.0	81.3	43.5
Total Organic Carbon (%)	4.52	16.4	11.1
Total Halogens (%)	0.0165	2.46	0.526
Carbon (%)	12.3	16.6	15.6
Hydrogen (%)	1.14	4.26	8.17
Nitrogen (%)	2.26	26.2	8.25
Oxygen (%)	19.7	20.3	51.5
Sulfur (%)	0.0764	0.372	0.502

[a] Source: U.S. EPA, 1989. Final Characterization Report for Cedar Chemical, Velsicol Chemical Corp., A.H. Robins, and O.M. Scott and Sons. (Reference 7).

[b] Two types of D016 were sampled at O.M. Scott and Sons, as described in Reference 7.

[c] The weight loss of air-dried samples is used to determine the moisture content of the samples. However, some of the weight loss may be due to the volatile organics present in the samples (notably, the heptachlor sample). Thus, the results for moisture content may be biased high.

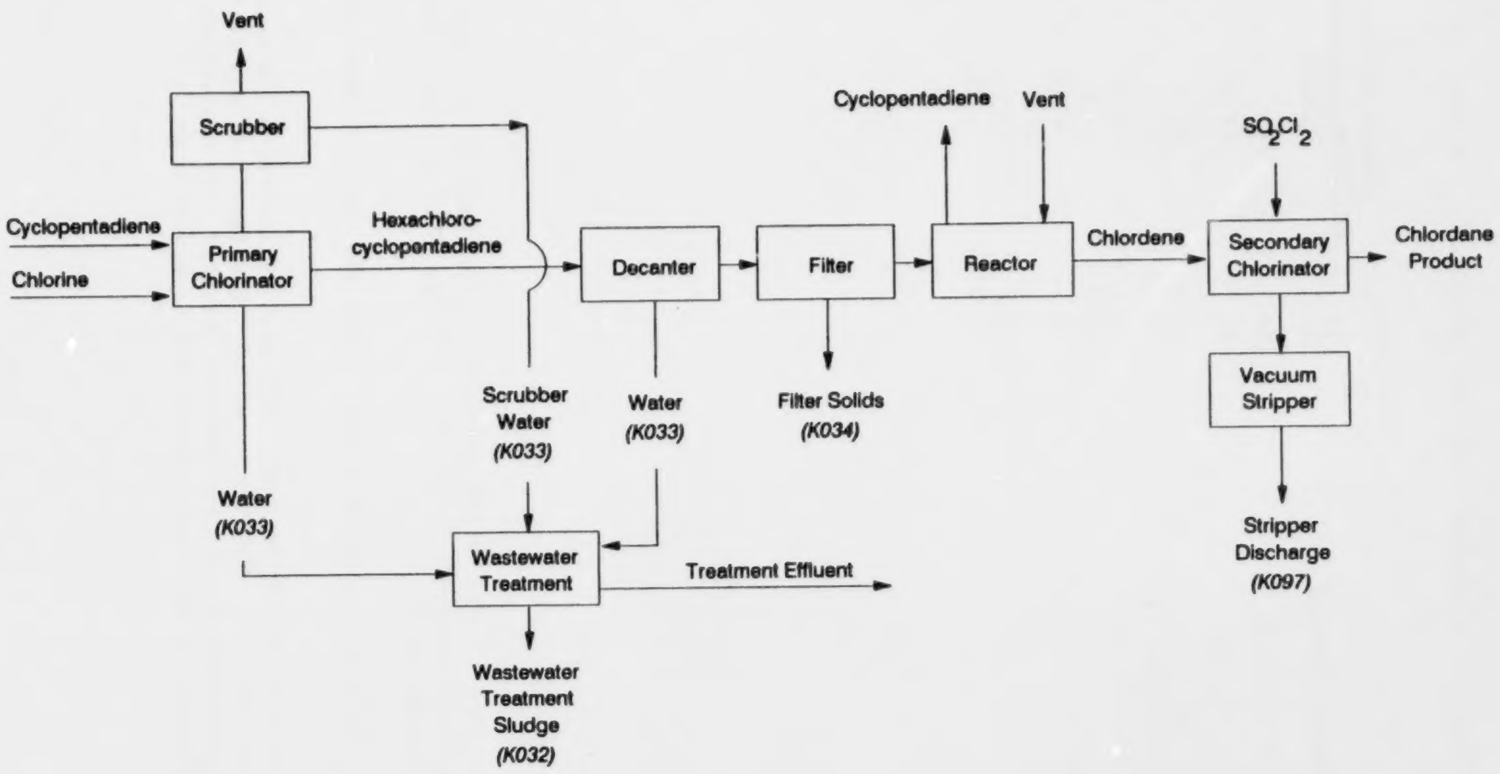
Vent
Scrubber
Cyclopentadiene
Chlorine
Primary Chlorinator
Hexachloro-cyclopentadiene
Decanter
Filter
Cyclopentadiene
Vent
Reactor
Chlordene
SO_2Cl_2
Secondary Chlorinator
Chlordane Product
Vacuum Stripper
Stripper Discharge (K097)
Filter Solids (K034)
Scrubber Water (K033)
Water (K033)
Water (K033)
Wastewater Treatment
Treatment Effluent
Wastewater Treatment Sludge (K032)

Figure 2-1. Chlordane Manufacturing Process

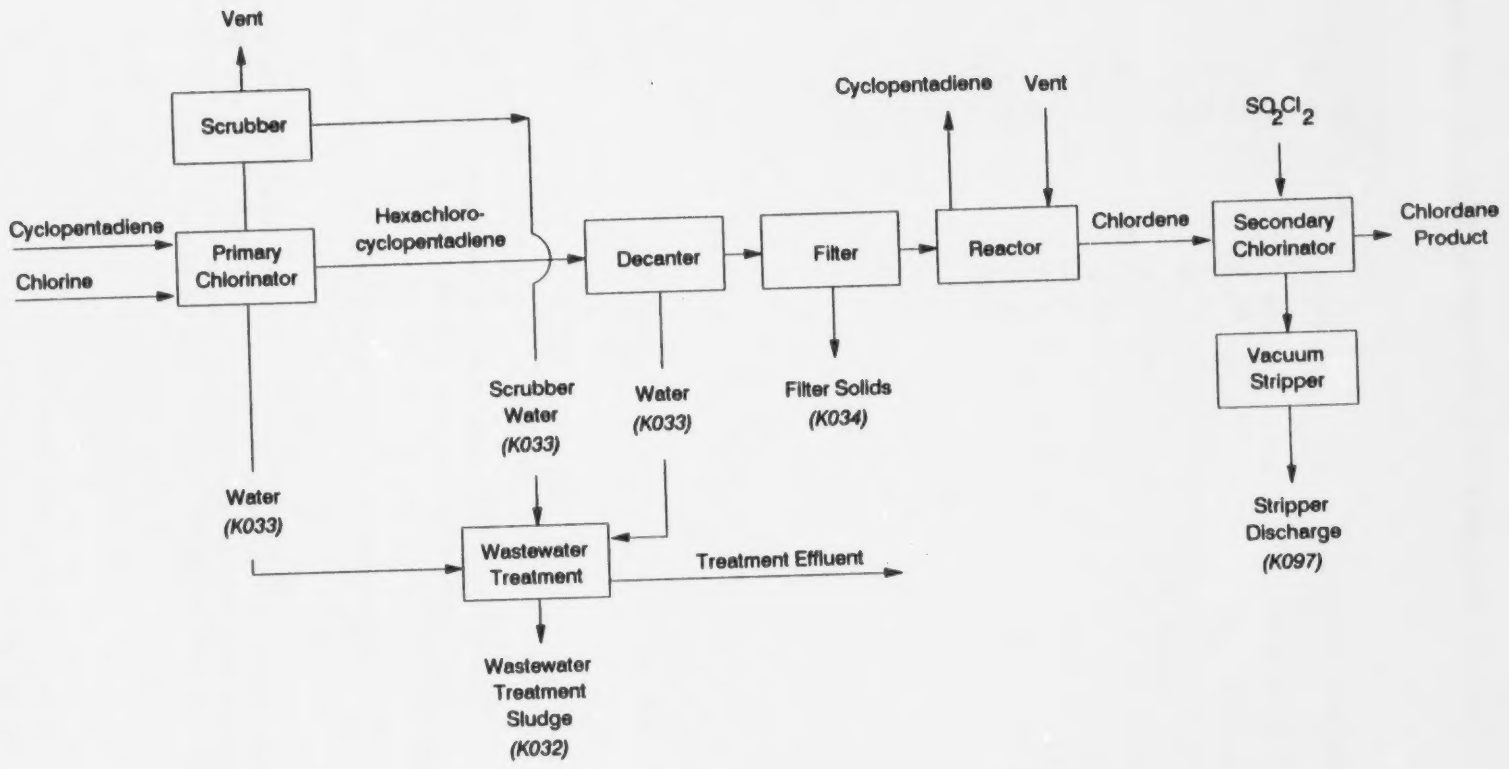
Vent
Scrubber
Cyclopentadiene
Chlorine
Primary Chlorinator
Hexachloro-cyclopentadiene
Decanter
Filter
Reactor
Cyclopentadiene
Vent
Chlordene
SO_2Cl_2
Secondary Chlorinator
Chlordane Product
Vacuum Stripper
Stripper Discharge (K097)
Filter Solids (K034)
Scrubber Water (K033)
Water (K033)
Water (K033)
Wastewater Treatment
Treatment Effluent
Wastewater Treatment Sludge (K032)

Figure 2-1. Chlordane Manufacturing Process

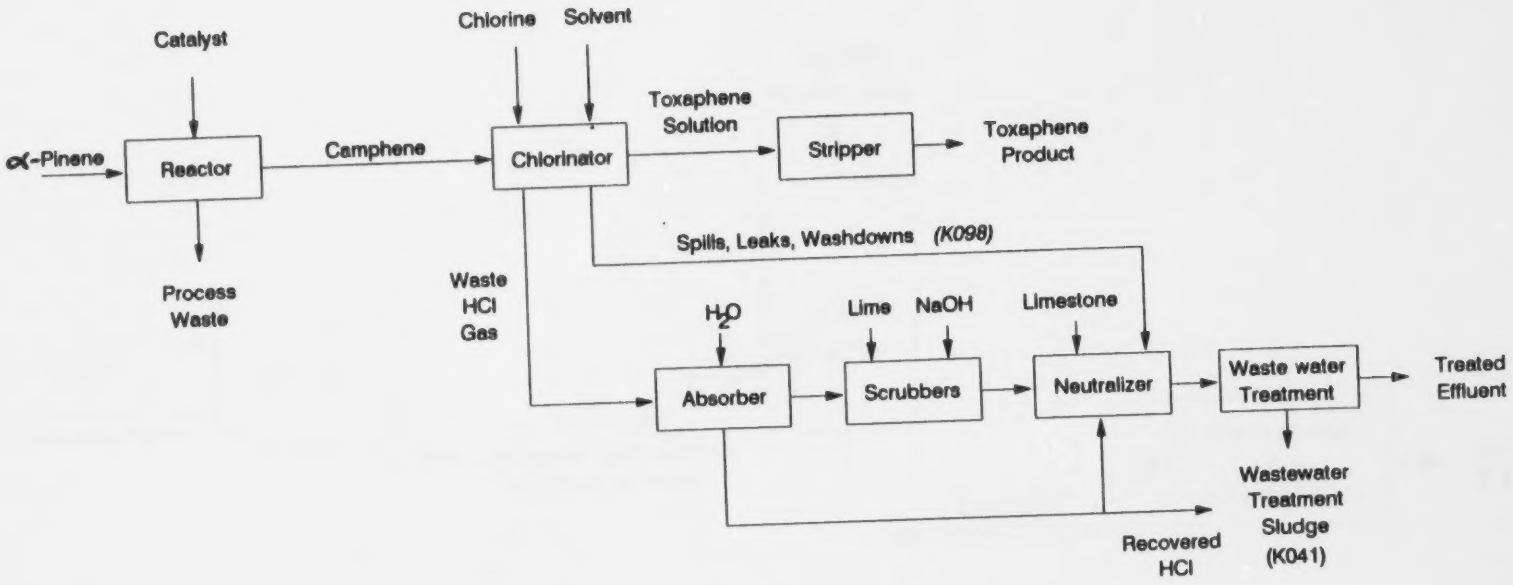
Catalyst
α-Pinene
Reactor
Process Waste
Camphene
Chlorine
Solvent
Chlorinator
Toxaphene Solution
Stripper
Toxaphene Product
Spills, Leaks, Washdowns (K098)
Waste HCl Gas
H_2O
Absorber
Lime
NaOH
Scrubbers
Limestone
Neutralizer
Waste water Treatment
Treated Effluent
Wastewater Treatment Sludge (K041)
Recovered HCl

Figure 2-2. Toxaphene Manufacturing Process

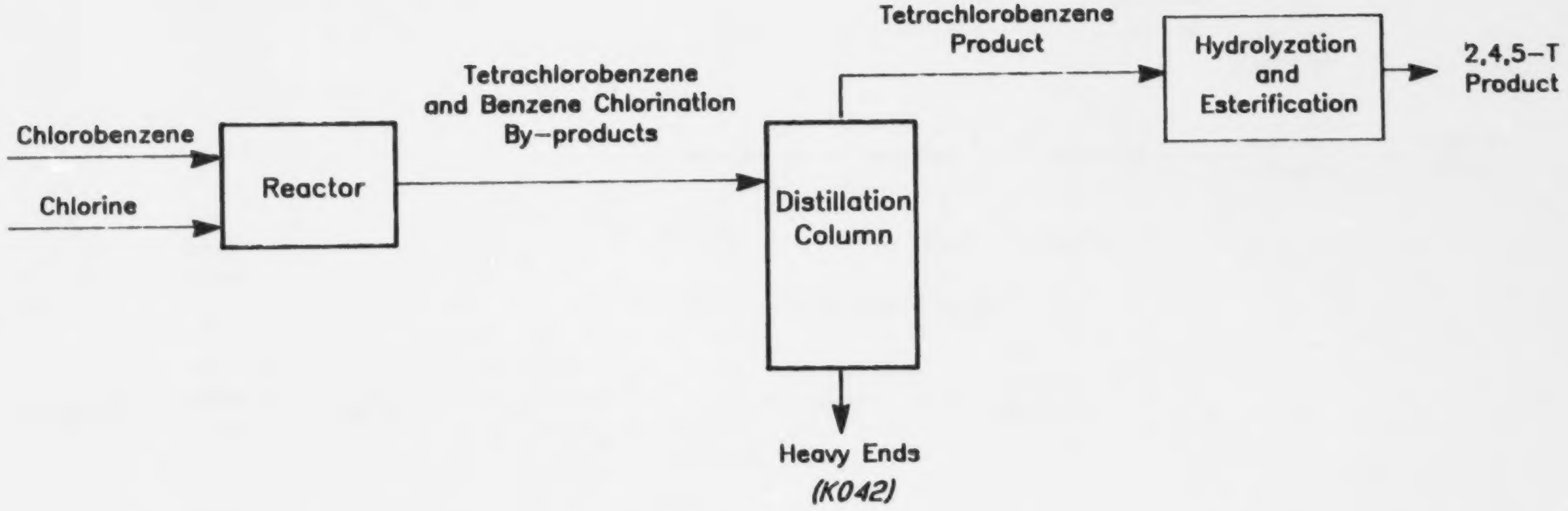
Chlorobenzene
Chlorine
Reactor
Tetrachlorobenzene and Benzene Chlorination By-products
Distillation Column
Heavy Ends (K042)
Tetrachlorobenzene Product
Hydrolyzation and Esterification
2,4,5-T Product

Figure 2-3. 2,4,5-T Manufacturing Process

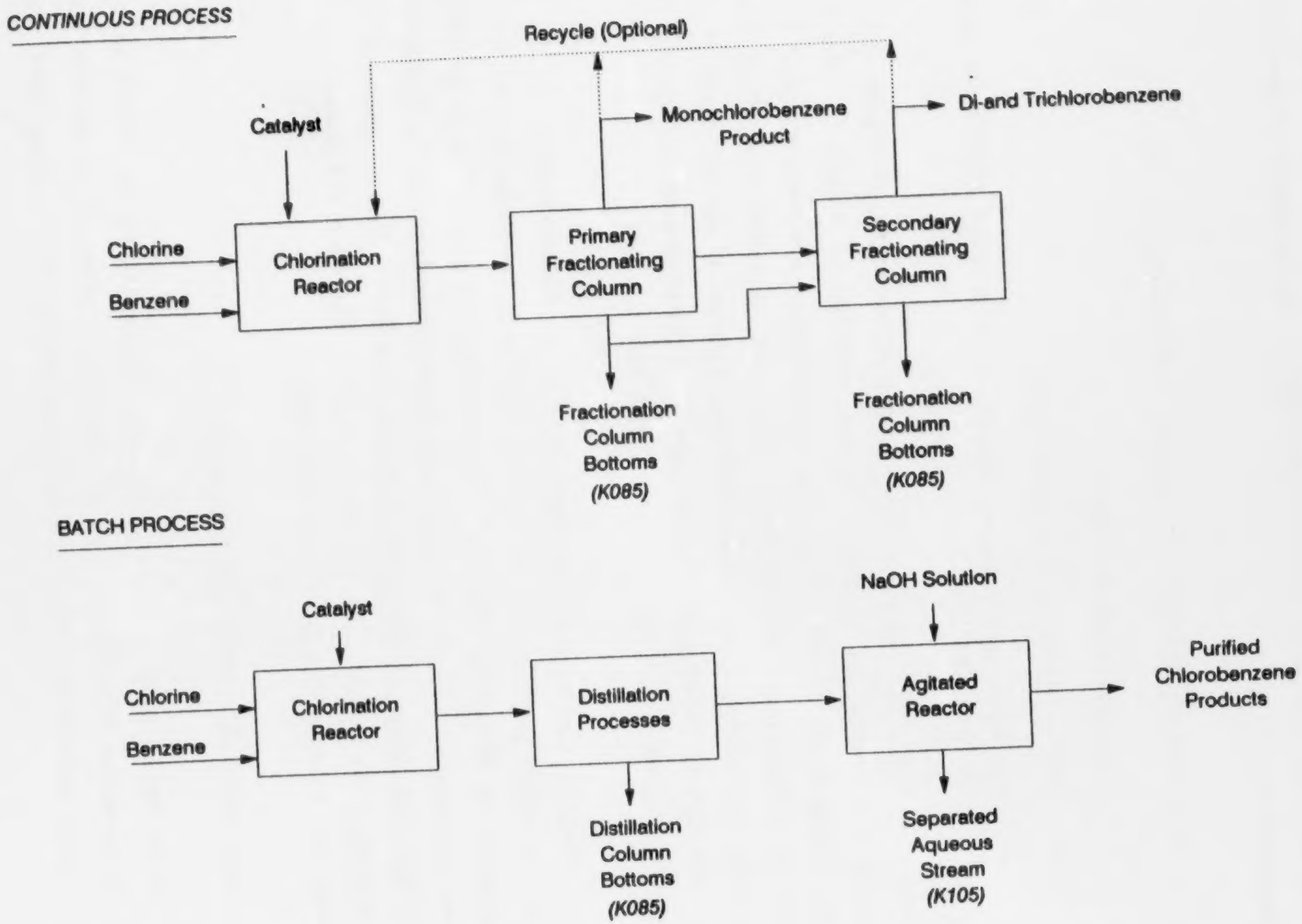
CONTINUOUS PROCESS
Recycle (Optional)
Catalyst
Chlorine
Benzene
Chlorination Reactor
Primary Fractionating Column
Monochlorobenzene Product
Secondary Fractionating Column
Di-and Trichlorobenzene
Fractionation Column Bottoms (K085)
Fractionation Column Bottoms (K085)
BATCH PROCESS
Catalyst
Chlorine
Benzene
Chlorination Reactor
Distillation Processes
Distillation Column Bottoms (K085)
NaOH Solution
Agitated Reactor
Separated Aqueous Stream (K105)
Purified Chlorobenzene Products

Figure 2-4. Chlorobenzenes Manufacturing Process

3.0 IDENTIFICATION OF APPLICABLE, DEMONSTRATED, AND BEST TECHNOLOGIES

This section presents the Agency's rationale for determining the best demonstrated available technologies (BDAT) for halogenated pesticide and chlorobenzene wastes.

This section presents the Agency's determination of:

- Applicable technologies;
- Demonstrated technologies; and
- The best demonstrated available technology (BDAT) for treatment of these wastes.

In determining BDAT, the Agency first determines which technologies are potentially applicable for treatment of the waste(s) of interest. The Agency then determines which of the applicable technologies are demonstrated for treatment of the waste(s) of interest. Next, EPA determines which of the demonstrated technologies are "best" for the purpose of establishing BDAT. Finally, the Agency determines whether the best demonstrated technology is available for treatment of the wastes of interest.

Integral to the determination of BDAT is the evaluation of all available treatment performance data. The treatment performance data that were evaluated to determine BDAT for these wastes are presented in Section 4.0 for nonwastewaters and in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A (Reference 17) for wastewaters. The data for wastewaters are also summarized in Appendix B of this document.

3.1 Applicable Treatment Technologies

To be applicable, a technology must theoretically be usable to treat the waste in question or a waste that is similar in terms of parameters that affect treatment selection. Detailed descriptions of technologies that are applicable to listed hazardous wastes are provided in EPA's Treatment Technology Background Document (Reference 8).

All of the wastes included in this document are organic. Therefore, the treatment technologies identified in this section are for treatment of hazardous organic constituents. Some of the wastes may contain metals at treatable concentrations as a result of the manner in which the waste was generated; however, the Agency is not identifying applicable, demonstrated, and available technologies for treatment of metal constituents in these wastes at this time.

Applicable treatment technologies for organic constituents in halogenated pesticide and chlorobenzene nonwastewaters are discussed below. Applicable treatment technologies for organic constituents in halogenated pesticide and chlorobenzene wastewaters are discussed in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A (Reference 17).

Since nonwastewater forms of these wastes may contain hazardous organic constituents at treatable concentrations, applicable treatment technologies include those that destroy or reduce the total amount of various organic compounds in the waste. The Agency has identified the following treatment technologies as applicable for these wastes:

- Incineration (fluidized-bed, rotary kiln, and liquid injection);
- Solvent extraction followed by incineration or recycle of the extract;
- Critical fluid extraction followed by incineration of the contaminated solvents; and
- Wet air oxidation.

These treatment technologies were identified based on current waste treatment practices and engineering judgment.

3.1.1 Incineration

Incineration is a destruction technology in which energy, as heat, is transferred to the waste to destabilize chemical bonds and destroy hazardous organic constituents. In a fluidized-bed incinerator, waste is injected into the fluidized-bed material (generally sand and/or incinerator ash), where it is heated to its ignition temperature. Heat energy from the combustion reactions is then transferred back to the fluidized bed. Ash is removed periodically during operation and during bed change-outs.

In a rotary kiln incinerator, wastes are fed into the elevated end of the kiln, and the rotation of the kiln mixes the waste with hot gases to heat the waste to its ignition temperature. Ash is removed from the lower end of the kiln. Combustion gases from the kiln enter the afterburner for complete destruction of waste constituents. Other wastes may also be injected into the afterburner.

In a liquid injection incinerator, liquid wastes are atomized and injected into the incinerator. In general, only wastes with low or negligible ash contents are amenable to liquid injection incineration. Therefore, this technology does not typically generate an ash residual.

Combustion gases from the incinerator are then fed to a scrubber system for cooling and removal of entrained particulates and acid gases, if present. In general, with the exception of liquid injection incineration, two residuals are generated by incineration processes: ash and scrubber water.

3.1.2 Solvent Extraction

Solvent extraction is a separation technology in which organics are removed from the waste due to greater constituent solubility in the solvent phase than in the waste phase. This technology generates two residuals: a treated waste residual and an extract. The extract may be recycled or may be treated by incineration.

3.1.3 Critical Fluid Extraction

Critical fluid extraction is a solvent extraction technology in which the solvent is brought to its critical state (liquid gas) to aid in the extraction of hazardous organic constituents from the wastes. After the extraction step, the solvent is returned to its normal gaseous state, generating a small volume of extract that is concentrated in hazardous organic constituents. This technology generates two residuals: a treated waste residual and an extract. The extract may be recycled or may be treated by incineration.

3.1.4 Wet Air Oxidation

Wet air oxidation is a destruction technology in which hazardous organic constituents in wastes are oxidized and destroyed under pressure at elevated temperatures in the presence of dissolved oxygen. This technology is applicable for wastes comprised primarily of water and up to 10% total organic constituents. Wet air oxidation generates one treatment residual: treated effluent. The treated effluent may require further treatment for hazardous organic constituents by carbon adsorption or PACT® treatment. Emissions from wet air oxidation may require further treatment by incineration.

3.2 Demonstrated Treatment Technologies

To be demonstrated, a technology must be employed in full-scale operation for treatment of the waste in question or a similar waste. Technologies available only at pilot- or bench-scale operations are not considered in identifying demonstrated technologies.

Demonstrated treatment technologies for halogenated pesticide and chlorobenzene nonwastewaters are discussed below. Demonstrated treatment technologies for organic constituents in halogenated pesticide and chlorobenzene wastewaters are discussed in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A (Reference 17).

The Agency has identified incineration as a demonstrated technology for treatment of nonwastewater forms of these wastes. Incineration is demonstrated on a full-scale operational basis for treatment of several of these nonwastewaters as determined from telephone contacts with pesticide manufacturers, formulators, packagers, and chemical manufacturers (Reference 23). In addition, for the land disposal restrictions program, the Agency tested rotary kiln incineration on a full-scale operational basis for treatment of the following waste constituents in each treatability group, as described in Section 4.0:

Halogenated Pesticides and Chlorobenzenes

Group 1 - Chlorinated Norbornane and Norbornene Derivatives

Hexachlorocyclopentadiene
Chlordane
Heptachlor

Group 2 - Chlorobenzenes

Chlorobenzene
1,2-Dichlorobenzene
1,4-Dichlorobenzene
Hexachlorobenzene
Pentachlorobenzene
Pentachloronitrobenzene
1,2,4,5-Tetrachlorobenzene

Group 3 - Chlorophenoxy Carboxylic Acids and Derivatives

2,4-Dichlorophenoxyacetic acid

Group 4 - Chlorinated Diphenyls

Methoxychlor

Group 5 - Chlorinated Aliphatics

Hexachlorobutadiene

The Agency believes that since incineration is demonstrated for treatment of these waste constituents, incineration is also demonstrated for all of the wastes included in each treatability group (including those covered in this document) based on similarities in chemical and physical properties, as discussed in Section 2.3.

The Agency is not aware of any facilities that treat nonwastewater forms of these wastes or wastes judged to be similar on a full-scale operational basis using solvent extraction, critical fluid extraction, or wet air oxidation; therefore, EPA believes that these technologies are not currently demonstrated for these wastes.

3.3 Identification of Best Demonstrated Available Technology (BDAT)

The best demonstrated available technology (BDAT) is determined based on a thorough review of all performance data available on treatment of the waste of concern or wastes judged to be similar. The treatment performance data that were evaluated for these wastes are presented in Section 4.0 for nonwastewaters and in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A (Reference 17) for wastewaters. The wastewater treatment data are also summarized in Appendix B of this document. The treatment performance data are first screened to determine:

- Whether the data represent operation of a well-designed and well-operated treatment system;
- Whether sufficient analytical quality assurance/quality control measures were employed to ensure the accuracy of the data; and
- Whether the appropriate measure of performance was used to assess the performance of the particular treatment technology.

With the exceptions of Tests 13 and 14 and the wastewaters data, all of the incineration data included in Section 4.0 represent BDAT for wastes in previous rulemakings and therefore have previously been judged to meet the above conditions. Treatment performance data and design and operating data for Tests 13 and 14 are included in Section 4.0. Treatment performance data for wastewaters are included in EPA's Final Best Demonstrated Available Technology (BDAT) Background document for U and P Wastes and Multi-Source Leachate (F039), Volume A (Reference 17). Since incineration is demonstrated for wastes judged to be similar to the wastes included in this document, and since incineration is the only technology demonstrated for treatment of these wastes, incineration is considered "best" for nonwastewater forms of these wastes for each treatability group. The "best" technologies for treatment of wastewater forms of these wastes differ by waste code, as listed below:

	Best Demonstrated Technology	
Waste Code(s)	Nonwastewaters	Wastewaters
K wastes	Incineration	Incineration
D012 and D015	Incineration	Biological treatment
D013	Incineration	Granular activated carbon
D014	Incineration	Wet air oxidation
D016	Incineration	Chemical oxidation using chlorine as an oxidizing agent and biological treatment
D017	Incineration	Chemical oxidation using chlorine as an oxidizing agent

Following the identification of "best," the Agency determines whether the best demonstrated technology is "available." An available treatment technology is one that (1) is not a proprietary or patented process that cannot be purchased or licensed from the proprietor (i.e., it must be commercially available), and (2) substantially diminishes the toxicity of the waste or substantially reduces the likelihood of migration of hazardous constituents from the waste.

The technologies identified as best demonstrated technologies for these wastes are all commercially available. Also, treatment performance data included in Section 4.0 and in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A (Reference 17) show substantial treatment for the waste constituents of concern and other similar constituents. Therefore, these technologies are "available" and are BDAT for treatment of the wastes included in this document.

4.0 TREATMENT PERFORMANCE DATA

This section presents the data available to EPA on the performance of treatment technologies that are BDAT for nonwastewater forms of the halogenated pesticide and chlorobenzene wastes. Treatment performance data for constituents in wastewater forms of these wastes are presented and discussed in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A (Reference 17).

The available treatment performance data are used elsewhere in this document to determine which treatment technologies represent BDAT (Section 3.0), to select constituents for regulation (Section 5.0), and to develop treatment standards (Section 6.0). In addition to using treatment performance data from full-scale operations, eligible data may include those developed at research facilities or obtained at less than full-scale operations, provided that the technology is demonstrated in full-scale operation for a similar waste or wastes.

Treatment performance data, to the extent that they are available to EPA, include the concentrations for a given constituent in the untreated and treated waste, values of operating parameters measured at the time the waste was treated, and values of relevant design parameters for the treatment technology.

Where data are not available on the treatment of the specific waste of concern, the Agency may elect to transfer performance data from the treatment of a similar waste or wastes, using a demonstrated treatment technology. The Agency's methodology for the transfer of treatment performance data is provided in EPA's Methodology for Developing BDAT Treatment Standards (Reference 2). Transfer of treatment performance data is technically valid in cases where the untested wastes are generated from similar industries or similar processing steps, or have waste characteristics affecting treatment selection and performance that are similar to those of the tested wastes.

In an effort to account for the wide range of physical forms of these wastes, EPA examined all available BDAT incineration data to develop treatment standards. Specifically, the Agency considered treatment performance data from the 14 incineration tests listed in Table 4-1 (all tables are presented at the end of this section). Facility locations for the incineration tests listed in Table 4-1 are included in Appendix C. In cases where an individual waste constituent of concern was detected in the untreated or treated wastes from one or more treatment tests, data from only those tests were used to develop treatment standards for that constituent. In cases where an individual waste constituent of concern was not detected in any of the untreated or treated wastes from the 14 treatment tests, detection limits achieved for that constituent in the ash residual from all the tests were used to develop treatment standards, as discussed in Section 6.0. Values of design and operating parameters for each treatment test can be found in the corresponding Onsite Engineering Report for each test (References 9 through 16 and 18 through 22).

The following subsections present and discuss the treatment performance data that were used to develop treatment standards for each waste treatability group.

4.1 Group 1 - Chlorinated Norbornane and Norbornene Derivatives

The Agency does not have performance data for treatment of K032, K033, K034, K041, K097, and K098 nonwastewaters. Therefore, treatment performance data were transferred from other tested similar wastes to develop treatment standards for these wastes. Sources of treatment performance data for potential transfer to K032, K033, K034, K041, K097, and K098 nonwastewaters include wastes previously tested by incineration. (This technology was identified as applicable and demonstrated for treatment of these wastes in Section 3.0.) Wastes previously tested by the Agency by incineration are listed in Table 4-1. EPA examined these wastes to identify the best data source(s), if any, for transfer of treatment performance data to K032, K033, K034, K041, K097, and K098 nonwastewaters. Specifically, EPA examined whether the untested wastes are (1) generated from similar industries or processing steps, and (2) whether the wastes have similar waste characteristics affecting treatment performance as the previously-tested wastes.

K032, K033, K034, K041, K097, and K098 are generated by the pesticides industry. The wastes treated by rotary kiln incineration in Test 13 (see Table 4-1) are also generated by the pesticides industry. As discussed in the Treatment Technology Background Document (Reference 8), waste characteristics that affect treatment performance for rotary kiln incineration include the thermal conductivity of the waste and the boiling points and bond dissociation energies of the constituents of concern. Because the K wastes of interest contain many of the same waste constituents as the wastes included in Test 13, they would have similar thermal conductivity, boiling points, and bond dissociation energies. Consequently, it is expected that similar treatment performance could be achieved for the K wastes of interest as for the tested wastes.

Based on the similarities discussed above, treatment performance data from Test 13 were transferred to K032, K033, K034, K041, K097, and K098. Tests 13 and 14 were conducted by the Agency at the same location. Wastes treated at Test 13 included a blend of D014, D016, commercial chemical products as surrogates for U127 and U192, heptachlor process waste as a surrogate for P059, and clean fill soil. Wastes treated at Test 14 included a blend of commercial chemical products as surrogates for U141, U028, P020, U112, U226, U239, U080, U220, U166, U161, and U188. Table 4-2 presents the BDAT List constituents detected in the untreated waste feed blends for Tests 13 and 14. Table 4-3 presents the BDAT List constituents detected in the kiln ash residual from Tests 13 and 14, and Table 4-4 presents the design and operating data for the rotary kiln and secondary combustor from Tests 13 and 14. Additional details of Tests 13 and 14 may be found in the Onsite Engineering Report for the Third Thirds Incineration Treatability Test (Reference 9).

The D wastes included in this treatability group are D012 and D015. These waste constituents were treated to concentrations below the detection limits in all 14 tests. Table 4-5 presents the highest detection limits for these waste constituents in ash for each test.

4.2 Group 2 - Chlorobenzenes

The Agency does not have performance data for treatment of K042, K085, and K105 nonwastewaters. Therefore, treatment performance data were transferred from other tested wastes to develop treatment standards for these K wastes. Sources of treatment performance data for potential transfer to K042, K085, and K105 nonwastewaters include wastes previously tested by incineration. (This technology was identified as applicable and demonstrated for treatment of these wastes in Section 3.0.) Wastes previously tested by the Agency by incineration are listed in Table 4-1. EPA examined these wastes to identify the best data source(s), if any, for transfer of treatment performance data to K042, K085, and K105 nonwastewaters. Specifically, EPA examined whether the untested wastes are (1) generated from similar industries or processing steps, and (2) whether the wastes have similar waste characteristics affecting treatment performance as the previously-tested wastes.

K085 and K105 are generated by the chlorinated organic chemicals industry, while K042 is generated by the pesticides industry. The wastes treated by rotary kiln incineration in Tests 4 and 11 (see Table 4-1) are generated by the chlorinated organic chemicals industry. The wastes treated by rotary kiln incineration in Test 13 (see Table 4-1) are generated by both the chlorinated organic chemicals and the pesticides industries. Similar to K042, K085, and K105, the wastes included in Tests 4 and 11 are generated by a separation process from the product stream, such as distillation or filtration. Unlike the K wastes of interest, however, the wastes from Tests 4 and 11 are generated from the production of, and are mainly composed of, chlorinated aliphatic compounds; K042, K085, and K105 are generated from the production of, and are mainly composed of, chlorinated aromatic compounds.

As discussed in the Treatment Technology Background Document (Reference 8), waste characteristics that affect treatment performance for rotary kiln incineration include the thermal conductivity of the waste and the boiling points and bond dissociation energies of the constituents of concern. The constituents comprising K042, K085, and K105 are mainly chlorinated aromatic compounds, which, based on structural stability, would be more difficult to treat than the aliphatic compounds comprising the wastes from Tests 4 and 11. The constituents comprising K042, K085, and K105 are most structurally similar to those treated in Test 13 and have similar thermal conductivity, boiling points, and bond dissociation energies; thus, the Agency expects that similar treatment performance by incineration could be achieved for the K wastes of interest as for the tested wastes.

Based on the similarities discussed above, treatment performance data from Test 13 were transferred to K042, K085, and K105. Treatment performance data and design and operating data for Test 13 are included in Tables 4-2 through 4-4. This test is briefly described in Section 4.1 of this document, and is discussed in more detail in the Onsite Engineering Report for the Third Thirds Incineration Treatability Test (Reference 9).

4.3 Group 3 - Chlorophenoxy Carboxylic Acids and Derivatives

The waste codes included in this treatability group are D016 and D017. The Agency has treatment performance data for the constituents that comprise the basis for listing of these characteristic wastes: 2,4-D and 2,4,5-TP. Table 4-6 includes the constituent concentrations for the untreated waste and ash for 2,4-D that was detected in Tests 13 and 14 (see Table 4-1). Table 4-7 presents available detection limits for 2,4,5-TP (Silvex) in ash for the 14 incineration tests.

4.4 Group 4 - Chlorinated Diphenyls

The waste included in this treatability group is D014. The Agency has treatment performance data for the constituent that comprises the basis for listing of this characteristic waste, methoxychlor. Table 4-8 includes the constituent concentrations for untreated waste and ash for methoxychlor that was detected in Test 13.

4.5 Group 5 - Chlorinated Aliphatics

The waste included in this treatability group is D013. The Agency has treatment performance data for the constituent that comprises the basis for listing of this characteristic waste, lindane. Table 4-9 presents the detection limits for lindane in ash in each of the 14 incineration tests.

Table 4-1

WASTES TESTED BY INCINERATION

Test Number	Waste Code(s) Tested	Technology Used
1	K001-Pentachlorophenol	Rotary Kiln
2	K001-Creosote	Rotary Kiln
3	K011,K013,K014	Rotary Kiln
4	K019	Rotary Kiln
5	K024	Rotary Kiln
6	K037	Rotary Kiln
7	K048,K051	Fluidized-Bed
8	K087	Rotary Kiln
9	K101	Rotary Kiln
10	K102	Rotary Kiln
11	F024	Rotary Kiln
12	K015	Liquid Injection
13	D014,D016,P059[a],U127[a],U192[a]	Rotary Kiln
14	U141[a],U028[a],P020[a],U112[a],U226[a], U239[a],U080[a],U220[a],U166[a],U161[a], U188[a]	Rotary Kiln

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[a] Commercial chemical products were used in these incineration tests as surrogates for these wastes.

Table 4-2

CHARACTERIZATION DATA FOR WASTE TREATED IN TESTS 13 AND 14

BDAT List Constituent	Concentration in the Untreated Waste from Test 13 (ppm)	Concentration in the Untreated Waste from Test 14 (ppm)
Volatile Organics		
7. Carbon tetrachloride	560	<5,000
38. Methylene chloride	63	87,000
229. Methyl isobutyl ketone	130	52,000
43. Toluene	63	69,000
45. 1,1,1-Trichloroethane	63	130,000
Semivolatile Organics		
70. Bis(2-ethylhexyl)phthalate	<19	28,000
73. 2-sec-Butyl-4,6-dinitropheno	<19	77,000
90. 2,4-Dichlorophenol	140	<400
110. Hexachlorobenzene	13,000	<400
111. Hexachlorobutadiene	22	<400
112. Hexachlorocyclopentadiene	120	<400
117. Isosafrole	<19	35,000
122. 1,4-Naphthoquinone	<19	28,000
142. Phenol	<19	13,000
144. Pronamide	24,000	<400
Metals		
154. Antimony	10.5	<2.4
155. Arsenic	2.2	<1.0
156. Barium	76.1	0.42
157. Beryllium	0.31	<0.1
158. Cadmium	<0.5	1.2
159. Chromium (Total)	41.2	1.2
160. Copper	27.9	9.8
161. Lead	3.8	4.4
163. Nickel	19.7	2.0
167. Vanadium	18.2	<0.3
168. Zinc	45.1	17.3
Inorganics		
169. Cyanide	<0.47	3.4
170. Fluoride	6	0.1
Organochlorine Pesticides		
177. Chlordane (alpha and gamma)	6,600	<2.0
186. Heptachlor	16,000	<0.99
190. Methoxychlor	50,000	<2.0

Source: Onsite Engineering Report for the Third Third Incineration Test (Reference 9).

Table 4-3

ANALYTICAL RESULTS FOR INCINERATOR ASH FROM TESTS 13 AND 14

BDAT List Constituent	Concentration in Kiln Ash Total Composition (mg/kg) Test 13				Concentration in Kiln Ash Total Composition (mg/kg) Test 14			
	Sample Set #1	Sample Set #2	Sample Set #3	Sample Set #4	Sample Set #1	Sample Set #2	Sample Set #3	Sample Set #4
Volatile Organics								
7. Carbon Tetrachloride	0.008	<0.005	<0.01	0.048	<0.01	<0.01	<0.01	<0.01
38. Methylene Chloride	<0.005	0.012	0.015	0.090	0.016	<0.01	<0.01	<0.01
Metals								
154. Antimony	8.4	<2.4	5.2	9.3	<2.4	<2.4	<2.4	2.8
155. Arsenic	2.1	2	2.5	2.1	3.1	2.8	3.0	2.4
156. Barium	59.3	12.4	22.8	82.2	12.3	9.3	16.1	17.4
157. Beryllium	0.21	<0.1	<0.1	0.26	<0.1	<0.1	<0.1	<0.1
159. Chromium (Total)	10	2.2	2.8	15.1	1.7	1.0	2.5	2.7
160. Copper	64	13.7	41.1	29.9	3.5	1.6	3.4	3.0
161. Lead	4	5	2	1.8	0.83	1.1	1.5	<0.5
162. Mercury	<0.1	0.61	<0.1	3.5	<0.1	<0.1	<0.1	<0.1
163. Nickel	15.2	3.7	14.4	18.5	1.5	1.3	2.5	2.3
167. Vanadium	8.5	1.9	2.5	12.3	5.7	4.6	6.7	9.2
168. Zinc	9.6	2.3	4.9	6.2	2.7	3.7	3.6	3.5
Inorganics								
170. Fluoride	0.4	0.4	NA	NA	NA	2.7	NA	NA
171. Sulfide	NA	3,060	NA	NA	NA	<1.0	NA	NA
Phenoxyacetic Acid Herbicides								
192. 2,4-Dichlorophenoxy acetic acid	0.021	<0.2	<0.2	<0.2	0.002	0.0019	0.002	0.002

NA - Not Analyzed.

Source: Onsite Engineering Report for the Third Third Incineration Test (Reference 9).

Table 4-4

DESIGN AND OPERATING DATA FOR THE INCINERATION SYSTEM AT TESTS 13 AND 14

TEST 13

Time of Data Collection	Corresponding Sample Set	Kiln Temperature (degrees F)	Solids Mixture Feed Rate (lbs/hr)	Kiln Rotational Speed (rpm)	Primary Afterburner Temperature (degrees F)
1200	pre-test	NR	740	0.32	NR
1300	pre-test	NR	740	0.32	NR
1345	pre-test	1400 - 1700	740	0.32	1700 - 1800
1545	pre-test	1400 - 1700	740	0.32	1700 - 1800
1615	pre-test	1400 - 1700	740	0.32	1700 - 1800
1630	pre-test	1400 - 1700	740	0.32	1700 - 1800
1645	pre-test	1400 - 1700	740	0.32	1700 - 1800
1700	sample set #1	1500 - 1700	740	0.32	1800
1715	sample set #1	1500 - 1700	740	0.32	1800
1730	sample set #1	1500 - 1700	740	0.32	1800
1745	sample set #1	1500 - 1700	740	0.32	1800
1815	sample set #2	1600 - 1800	740	0.32	1800 - 1900
1830	sample set #2	1600 - 1800	740	0.32	1800 - 1900
1845	sample set #2	1600 - 1800	740	0.32	1800 - 1900
1900	sample set #3	1700 - 1900	740	0.32	1800 - 1900
1930	sample set #3	1700 - 1900	740	0.32	1800 - 1900
2000	sample set #4	1600 - 1800	740	0.32	1800
2015	sample set #4	1600 - 1800	740	0.32	1800
2030	sample set #4	1600 - 1800	740	0.32	1800
2045	sample set #4	1600 - 1800	740	0.32	1800

TEST 14

Time of Data Collection	Corresponding Sample Set	Kiln Temperature (degrees F)	Soil Feed Rate (lbs/hr)	Liquid Mixture Feed Rate (gal/hr)	Kiln Rotational Speed (rpm)	Primary Afterburner Temperature (degrees F)
0830	pre-test	1600 - 1800	540	0	0.25	1800
0915	begin liquid feed	1600 - 1800	NR	24	NR	NR
0930	pre-test	1600 - 1800	540	28	0.25	1800
1000	pre-test	1600 - 1800	540	28	0.25	1800
1055	sample set #1	1700	540	28	0.25	1700 - 1800
1145	sample set #2	1700	540	28	0.25	1800
1215	sample set #2	1700	540	28	0.25	1800
1245	sample set #3	1700	540	28	0.25	1800
1315	sample set #3	1700	540	28	0.25	1800
1345	sample set #4	1700 - 1800	540	28	0.25	1600 - 2000
1410	kiln shut off	1800	NR	NR	0.25	1800

NR - Not Reported.

Source: Onsite Engineering Report for the Third Third Incineration Test (Reference 9).

Table 4-5

DETECTION LIMITS FOR WASTE CONSTITUENTS IN GROUP 1 OF THE HALOGENATED PESTICIDES AND CHLOROBENZENES TREATABILITY GROUP

Waste Code	BDAT #	Constituent	Test No.* ->	Detection Limit (ppm) 1	2	3	4	5	6	7	8	9	10	11	12	13	14
Incinerator Ash																	
D012	184	Endrin		NA	0.001	0.000015	NA	NA	0.001	NA	NA	NA	NA	NA	**	0.013	0.013
D015	191	Toxaphene		NA	0.1	0.0002	NA	NA	0.1	NA	NA	NA	NA	NA	**	0.13	0.13

* - Treatment test # as indicated in Table 4-1.

** - Incinerator ash samples were not collected for Test 12.

NA - Not Available

Table 4-6

WASTE CONSTITUENT IN GROUP 3 OF THE HALOGENATED PESTICIDES AND CHLOROBENZENES TREATABILITY GROUP DETECTED IN THE UNTREATED OR TREATED WASTES

Waste Code	BDAT #	Waste Constituent	Treatment Test Detected In (#)*	Concentration In Untreated Waste (ppm)**	Concentration In Ash (ppm/[# of sample sets])**
D016	192	2,4-Dichlorophenoxyacetic acid	13	0.35 - 17	0.002[1] <0.2[3]
			14	0.35 - 17	<0.002[2] 0.067[1] 0.23[1]

* - Treatment test # is indicated in Table 4-1.

** - Number in parentheses indicates the number of sample sets for which the value was reported.

Table 4-7

DETECTION LIMITS FOR WASTE CONSTITUENT IN GROUP 3 OF THE HALOGENATED PESTICIDES AND CHLOROBENZENES TREATABILITY GROUP

Waste Code	BDAT #	Constituent	Test No.* ->	Detection Limit (ppm)													
				1	2	3	4	5	6	7	8	9	10	11	12	13	14
Incinerator Ash																	
D017	193	2,4,5-TP (Silvex)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	**	0.2	0.002

* - Treatment test # as indicated in Table 4-1.

** - Incinerator ash samples were not collected for Test 12.

NA - Not Available

Table 4-8

WASTE CONSTITUENT IN GROUP 5 OF THE HALOGENATED PESTICIDES AND CHLOROBENZENES TREATABILITY GROUP DETECTED IN THE UNTREATED OR TREATED WASTES

Waste Code	BDAT #	Waste Constituent	Treatment Test Detected In (#)*	Concentration In Untreated Waste (ppm)**	Concentration In Ash (ppm/[# of sample sets])**
D014	190	Methoxychlor	13	50,000 - 190,000	<0.013[4]

* - Treatment test # as indicated in Table 4-1.

** - Number in parentheses indicates the number of sample sets for which the value was reported.

Table 4-9

DETECTION LIMITS FOR WASTE CONSTITUENT IN GROUP 5 OF THE HALOGENATED PESTICIDES AND CHLOROBENZENES TREATABILITY GROUP

				Detection Limit (ppm)													
Waste Code	BDAT #	Constituent	Test No.* ->	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Incinerator Ash																	
D013	176	gamma-BHC (Lindane)		NA	0.001	0.000001	NA	NA	0.001	NA	NA	NA	NA	NA	**	0.0066	0.0066

* - Treatment test # as indicated in Table 4-1.

** - Incinerator ash samples were not collected for Test 12.

NA - Not Available

5.0 SELECTION OF REGULATED CONSTITUENTS

This section presents EPA's methodology and rationale for selection of regulated constituents in nonwastewater and wastewater forms of halogenated pesticide and chlorobenzene wastes. Generally, constituents selected for regulation must satisfy the following criteria:

1. The constituent must be on the BDAT List of constituents. (Presence on the BDAT List means that EPA-approved methods exist for analyzing the constituent in treated waste matrices.)
2. The constituent must be present, or be suspected of being present, in the untreated waste. For example, analytical difficulties may prevent a constituent from being identified in the untreated waste, but its identification in a treatment residual may lead the Agency to conclude that it is present in the untreated waste.

For the K wastes, the Agency initially considered all constituents on the BDAT List for regulation. BDAT List constituents were deleted from further consideration for regulation if: (1) the constituent was not detected in the untreated waste and was not suspected of being present in the untreated waste; or (2) the constituent was not analyzed for in the untreated waste. Table 5-1, at the end of this section, summarizes available waste characterization data for K032, K033, K034, K041, K042, K085, K097, K098, and K105 for the BDAT List constituents (as derived from Table 2-3). Ranges of concentrations for constituents detected in the wastes are shown in the table.

All constituents detected in K032, K033, K034, K041, K042, K085, K097, K098, and K105 have been selected for regulation. In addition, waste constituents expected to be present in the untreated wastes as indicated in Table 5-1 were also selected for regulation; K032 and K097 are expected to contain chlordane and heptachlor. The Agency believes that heptachlor can be commonly converted to heptachlor epoxide in environmental samples. Therefore, the Agency is also selecting heptachlor epoxide for regulation in K032 and K097.

Due to the limited characterization data for D012-D017, only the constituents for which these wastes were listed have been selected for regulation. The waste constituents selected for regulation in halogenated pesticide and chlorobenzene nonwastewaters and wastewaters are summarized in Table 5-2.

Table 5-1

STATUS OF BDAT LIST CONSTITUENTS IN UNTREATED K-PESTICIDES WASTES[a]

BDAT List Constituent		Untreated Waste Concentration (%)								
		K032	K033	K034	K041	K042	K085	K097	K098	K105
Volatiles										
4.	Benzene	NA	NA	NA	NA	NA	trace-1	NA	NA	0.18
9.	Chlorobenzene	NA	NA	NA	NA	NA	0.1-50	NA	NA	0.008
Semivolatiles										
78.	2-Chlorophenol	NA	NA	NA	NA	NA	NA	NA	NA	E
87.	o-Dichlorobenzene	NA	NA	NA	NA	10	NA	NA	NA	0.05
88.	p-Dichlorobenzene	NA	NA	NA	NA	35	NA	NA	NA	0.05
86-88.	Dichlorobenzenes	NA	NA	NA	NA	NA	1-50	NA	NA	NA
110.	Hexachlorobenzene	NA	NA	NA	NA	NA	E	NA	NA	NA
112.	Hexachlorocyclopentadiene	5-75	E	5-25	NA	NA	NA	E	NA	NA
136.	Pentachlorobenzene	NA	NA	NA	NA	25	E	NA	NA	NA
142.	Phenol	NA	NA	NA	NA	NA	NA	NA	NA	E
148.	1,2,4,5-Tetrachlorobenzene	NA	NA	NA	NA	E	0.01-10	NA	NA	NA
150.	1,2,4-Trichlorobenzene	NA	NA	NA	NA	20	1-10	NA	NA	NA
151-152.	Trichlorophenols	NA	NA	NA	NA	NA	NA	NA	NA	E
Organochlorine Pesticides										
177.	Chlordane	E	NA	NA	NA	NA	NA	E	NA	NA
186.	Heptachlor	E	NA	NA	NA	NA	NA	E	NA	NA
191.	Toxaphene	NA	NA	NA	1	NA	NA	NA	E	NA
Polychlorinated Biphenyls (PCBs)										
200-206.	Aroclors	NA	NA	NA	NA	NA	0.1-1	NA	NA	NA

NA - Not analyzed.

E - Expected to be present in the waste; however, no quantitative data are available.

[a] BDAT List constituents not detected or not expected to be present in these wastes are not shown on this table.

Table 5-2

BDAT LIST CONSTITUENTS SELECTED FOR REGULATION IN HALOGENATED PESTICIDE AND CHLOROBENZENE NONWASTEWATERS AND WASTEWATERS

Waste Code	BDAT List Constituent	
D012	184.	Endrin
D013	176.	gamma-BHC (Lindane)
D014	190.	Methoxychlor
D015	191.	Toxaphene
D016	192.	2,4-D
D017	193.	2,4,5-TP (Silvex)
K032	112.	Hexachlorocyclopentadiene
	177.	Chlordane
	186.	Heptachlor
	187.	Heptachlor epoxide
K033	112.	Hexachlorocyclopentadiene
K034	112.	Hexachlorocyclopentadiene
K041	191.	Toxaphene
K042	87.	o-Dichlorobenzene
	88.	p-Dichlorobenzene
	136.	Pentachlorobenzene
	148.	1,2,4,5-Tetrachlorobenzene
	150.	1,2,4-Trichlorobenzene
K085	4.	Benzene
	9.	Chlorobenzene
	86-88.	Dichlorobenzenes
	110.	Hexachlorobenzene
	136.	Pentachlorobenzene
	148.	1,2,4,5-Tetrachlorobenzene
	150.	1,2,4-Trichlorobenzene
	200-206.	Aroclors (PCBs)
K097	112.	Hexachlorocyclopentadiene
	177.	Chlordane
	186.	Heptachlor
	187.	Heptachlor epoxide
K098	191.	Toxaphene
K105	4.	Benzene
	9.	Chlorobenzene
	78.	2-Chlorophenol
	87.	o-Dichlorobenzene
	88.	p-Dichlorobenzene
	142.	Phenol
	151-152.	Trichlorophenols

6.0 CALCULATION OF BDAT TREATMENT STANDARDS

The purpose of this section is to calculate treatment standards for the constituents selected for regulation in Section 5.0 using the available treatment performance data from the BDAT treatment technologies. A discussion of how the treatment standards for the D and K wastes were determined is included in this section.

6.1 D Wastes

6.1.1 Nonwastewaters

Treatment standards for D012-D017 nonwastewaters were calculated based on data compiled from the BDAT incineration database for incinerator ash residuals. Specifically, the Agency considered treatment performance data from the 14 incineration tests listed in Table 4-1.

For D012-D017 nonwastewaters, the Agency first determined whether the waste constituents were detected in the untreated or treated wastes included in any of the 14 treatment tests. Data for these waste codes are included in Section 4.0. For waste constituents that were detected in the untreated or treated waste, treatment standards were developed based on the highest detection limits in ash from these tests. For waste constituents that were not detected in any of the untreated or treated wastes in the 14 treatment tests, the Agency developed treatment standards based on the highest detection limits for the ash residuals in the 14 treatment tests.

Treatment standards for waste constituents selected for regulation in Section 5.0 were calculated by multiplying the constituent detection limit in ash by an accuracy correction factor and by a variability factor. The following sections discuss these three components of the treatment standard calculation. Treatment standards for D012-D017 nonwastewaters are presented in Tables 6-1 through 6-5, at the end of this section.

Detection Limits

Detection limits (presented in Section 4.0) for the ash residuals were used to calculate treatment standards for D012-D017 nonwastewaters. In cases where the waste constituent was detected in more than one incineration test, the highest detection limits for the ash and scrubber water were used. For example, 2,4-D (D016) was detected in two treatment tests (13 and 14), as indicated in Table 4-6. The highest detection limit for the ash samples was 0.2 ppm in Test 13. Therefore, 0.2 ppm is shown in Table 6-3 for 2,4-D nonwastewaters.

For waste constituents not detected in any of the 14 tests, the highest detection limit reported for the 14 treatment tests was used. For example, endrin (D012) was not detected in any of the 14 treatment tests. Detection limits for this constituent range from 0.000015 ppm to 0.013 ppm, as indicated in Table 4-5. Therefore, the detection limit of 0.013 ppm in Tests 13 and 14 is shown in Table 6-1 for endrin nonwastewaters.

Accuracy Correction Factors

The detection limits used to calculate treatment standards were corrected using matrix spike recovery data from the same test from which the detection limits were taken to account for analytical interferences associated with the chemical matrices of the samples. Detection limits were corrected for accuracy as follows:

- A matrix spike recovery was determined for each waste constituent. In cases where a matrix spike was not performed for a waste constituent from the treatment test for which the detection limit was used, the matrix spike recovery from a similar constituent from that treatment test was transferred to that constituent. The source of recovery data used for each constituent is indicated in Tables 6-1 through 6-5;

- An accuracy correction factor was determined for each of the above constituents by dividing 100 by the matrix spike recovery (expressed as a percent) for that constituent; and

- Detection limits for each waste constituent were corrected by multiplying the reported concentration of each constituent by its corresponding accuracy correction factor.

Matrix spike recoveries used to adjust detection limits for each of the 14 incineration tests are included in Appendix D. Duplicate matrix spikes were performed for some waste constituents. If a duplicate matrix spike was performed for a constituent, the matrix spike recovery used for that constituent was the lower of the two values from the first matrix spike and the duplicate spike. Matrix spike recoveries of less than 20% are not acceptable and were not used to correct detection limits. Matrix spike recoveries greater than 100% were considered to be 100% for the purpose of this calculation so that the data were not adjusted to concentrations below the detection limits. In cases where the detection limit used was from more than one test, matrix spike recovery data from the test resulting in the highest accuracy correction factor was used. The test from which matrix spike recovery data were used is indicated in Tables 6-1 through 6-5. Acceptable matrix spike recoveries for incinerator ash were not available for phenoxyacetic acid herbicides in Test 13. Therefore, a recovery of 20% was used for 2,4-D and 2,4,5-TP.

Variability Factors

The variability factor accounts for the variability inherent in treatment system performance, treatment residual collection, and analysis of the treated waste samples. Variability factors could not be calculated for waste constituents that were not detected in the incinerator ash or scrubber water residuals. In these cases, a variability factor of 2.8 was used to account for this inherent variability. In the case of D016, 2,4-D was detected in the ash, and a variability factor could be calculated. This variability factor calculation is included in Appendix E. The variability factors used to calculate the treatment standards for each of the waste constituents are included in Tables 6-1 through 6-5.

6.1.2 Wastewaters

The Agency prefers, whenever possible, to set concentration-based treatment standards for listed wastes so as not to limit the selection of those treatment technologies that may be used to achieve the BDAT treatment standards. In cases where concentration-based standards cannot be established, EPA may choose to establish a method of treatment as the treatment standard.

In the case of wastewater forms of the characteristic pesticide wastes (D012-D017), the Agency is specifying methods of treatment as the treatment standards. This decision is discussed further in Section III.A of the preamble for the promulgated Third Third Rule.

Incineration was determined to be BDAT for nonwastewater forms of D012-D017, as discussed in Section 3.0. The Agency has determined that organic-bearing wastewaters are also treated by incineration and does not intend to preclude industry from continuing this practice. Additionally, the Agency has identified the following treatment technologies as BDAT for wastewater forms of D012-D017, as discussed in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A (Reference 17):

Waste Code(s)	BDAT for Wastewaters
D012 and D015	Biological treatment
D013	Granular activated carbon
D014	Wet air oxidation
D016	Chemical oxidation using chlorine as an oxidizing agent and biological treatment
D017	Chemical oxidation using chlorine as an oxidizing agent

Accordingly, the Agency is establishing incineration or the treatment technology identified as BDAT for each of the D pesticide wastes, as listed above, as methods of treatment for D012-D017 wastewaters.

6.2 K Wastes

6.2.1 Nonwastewaters

The Agency calculates concentration-based treatment standards for regulated constituents based on the performance of well-designed and well-operated BDAT treatment systems. These standards account for analytical limitations in available treatment performance data and for variabilities related to treatment, sampling, and analytical techniques and procedures.

Treatment performance data are not available for the K wastes included in this document. Therefore, treatment performance data were transferred from the incineration of similar wastes, as discussed in Section 4.0. Treatment standards for these wastes were calculated as described below.

Before treatment standards were calculated, the treatment performance data were corrected to account for analytical interferences associated with the chemical matrices of the samples. A complete discussion of the accuracy correction of treatment data is provided in Appendix D. Appendix D also contains the matrix spike recoveries and accuracy correction factors used to correct the treatment performance data, as well as the corrected treatment performance data.

After treatment performance data were corrected for accuracy, the arithmetic average of the treatment performance data was calculated for each regulated constituent. In cases where the constituent was not detected, the detection limit was used to calculate the average constituent concentration in the treated waste.

The next step in calculating the treatment standards was to determine the variability factor (VF) for each regulated constituent. The variability factor accounts for the variability inherent in treatment system performance, treatment residual collection, and analysis of the treated waste samples. (For more information on the calculation of variability factors, see EPA's Methodology for Developing BDAT Treatment Standards (Reference 2).)

Finally, treatment standards were calculated for regulated constituents by multiplying the average of the corrected treatment performance values by the variability factor for the constituent. Details concerning the calculation of treatment standards are described below by treatability group.

Group 1 - Chlorinated Norbornane and Norbornene Derivatives

Treatment performance data for rotary kiln incineration of K032, K033, K034, K041, K097, and K098 are not available. Therefore, the Agency is transferring treatment performance data from rotary kiln incineration of wastes from Test 13 to these waste codes. Specifically, treatment standards for K032, K033, K034, K041, K097, and K098 nonwastewaters were calculated based on total constituent concentration data transferred from incinerator ash generated during Test 13. The rationale for this transfer is presented in Section 4.0.

Treatment standards for K032, K033, K034, K041, K097, and K098 were calculated using four sets of incinerator ash data from Test 13. Tables 4-2 and 4-3 of Section 4.0 present the total concentration of each constituent detected in the untreated waste and the treated nonwastewater residual from Test 13. Constituents selected for regulation in K032, K033, K034, K041, K097, and K098 are hexachlorocyclopentadiene, chlordane, heptachlor, heptachlor epoxide, and toxaphene. Hexachlorocyclopentadiene, chlordane, and heptachlor were detected in the untreated waste from Test 13. Accordingly, data from treatment of these three constituents were used to develop treatment standards for the five constituents regulated in these K wastes.

The Agency believes that, based on structural similarities, the heptachlor epoxide being regulated in K032 and K097 would be treated to concentrations similar to those achieved for heptachlor, and therefore, transferring performance data for heptachlor to heptachlor epoxide is valid.

Chlordane is a mixture of alpha and gamma isomers that are generally difficult to distinguish analytically. Therefore, treatment performance data for chlordane represent the sum of these isomers. Since toxaphene is also a mixture of several isomers that are difficult to distinguish analytically, treatment performance data for chlordane were transferred to toxaphene for the purpose of developing treatment standards. The Agency believes that, based on structural similarities, chlordane and toxaphene would be treated to similar concentrations, and therefore, transferring treatment performance data for chlordane to toxaphene is valid. The detection limits for toxaphene are typically ten times greater than those of chlordane. This factor was accounted for in developing the treatment standard for toxaphene. Table 6-1 summarizes the calculation of treatment standards for these wastes.

Group 2 - Chlorobenzenes

Treatment performance data for rotary kiln incineration of K042, K085, and K105 are not available. Therefore, the Agency is transferring treatment performance data from rotary kiln incineration of wastes from Test 13 to these waste codes. Specifically, treatment standards for K042, K085, and K105 nonwastewaters were calculated based on total constituent concentration data transferred from incinerator ash generated during Test 13. The rationale for this transfer is presented in Section 4.0.

Treatment standards for K042, K085, and K105 were calculated using four sets of incinerator ash data from Test 13. Tables 4-2 and 4-3 of Section 4.0 present the total concentration of each constituent detected in the untreated waste and the treated residuals from Test 13. Since the constituents selected for regulation in K042, K085, and K105 were not detected in the untreated waste incinerated in Test 13, data from treatment of hexachlorobenzene and methoxychlor were used to develop treatment standards for waste constituents of concern in K042, K085, and K105. Table 6-2 summarizes the calculation of treatment standards for these wastes.

The Agency believes that, based on structural similarities, the chlorinated benzene and phenolic constituents regulated in K042, K085, and K105 would be treated to concentrations similar to those achieved for hexachlorobenzene, and therefore, transferring performance data for hexachlorobenzene to these constituents is valid. For the same reasons, the Agency transferred treatment performance data for methoxychlor to the PCBs regulated in K085. The typical ratio of the detection limit for methoxychlor to those for each of the PCBs was taken into account in the treatment standard calculation.

6.2.2 Wastewaters

A discussion of the treatment standard calculations for wastewater forms of the K wastes is provided in EPA's Final Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A (Reference 17).

Table 6-1

CALCULATION OF TREATMENT STANDARDS FOR HALOGENATED PESTICIDES AND CHLOROBENZENES - GROUP 1 (CHLORINATED NORBORNANE AND NORBORNENE DERIVATIVES)

Regulated Constituent (SW-846 Method Number)	Constituent From Which Treatment Performance Data Were Transferred	Arithmetic Average of Corrected Treatment Performance Values (ppm)	Variability Factor (VF)	Treatment Standard (Average x VF) (ppm)
NONWASTEWATERS				
Semivolatile Organics (8270)				
K032 Hexachlorocyclopentadiene	Hexachlorocyclopentadiene	0.86	2.8	2.4
K033 Hexachlorocyclopentadiene	Hexachlorocyclopentadiene	0.86	2.8	2.4
K034 Hexachlorocyclopentadiene	Hexachlorocyclopentadiene	0.86	2.8	2.4
K097 Hexachlorocyclopentadiene	Hexachlorocyclopentadiene	0.86	2.8	2.4
Organochlorine Pesticides (8080)				
K032 Chlordane (alpha and gamma)	Chlordane (alpha and gamma)	0.093	2.8	0.26
Heptachlor	Heptachlor	0.024	2.8	0.066
Heptachlor epoxide	Heptachlor	0.024	2.8	0.066
K041 Toxaphene	Chlordane	0.93	2.8	2.6
K097 Chlordane (alpha and gamma)	Chlordane (alpha and gamma)	0.093	2.8	0.26
Heptachlor	Heptachlor	0.024	2.8	0.066
Heptachlor epoxide	Heptachlor	0.024	2.8	0.066
K098 Toxaphene	Chlordane	0.93	2.8	2.6

Table 6-1 (Continued)

CALCULATION OF TREATMENT STANDARDS FOR HALOGENATED PESTICIDES AND CHLOROBENZENES - GROUP 1 (CHLORINATED NORBORNANE AND NORBORNENE DERIVATIVES)

Waste Code	BDAT #	Constituent	Detection Status in Untreated or Treated Waste (Y or N)	Detection Limit (ppm)	Detection Limit Taken From Test #(s)*	Matrix Spike Recovery (%)	Recovery Data Transferred From (BDAT #/Test #)*	Accuracy Correction Factor	Corrected Detection Limit (ppm)	Variability Factor	Treatment Standard (ppm)
NONWASTEWATERS											
D012	184	Endrin	N	0.013	13,14	28	186/13	3.57	0.046	2.8	0.13
D015	191	Toxaphene	N	0.13	13,14	28	186/13	3.57	0.46	2.8	1.3

* Treatment test number is indicated in Table 4-1.

Table 6-2

CALCULATION OF TREATMENT STANDARDS FOR HALOGENATED PESTICIDES AND CHLOROBENZENES K WASTES - GROUP 2 (CHLOROBENZENES)

Regulated Constituent (SW-846 Method Number)	Constituent From Which Treatment Performance Data Were Transferred	Arithmetic Average of Corrected Treatment Performance Values (ppm)	Variability Factor (VF)	Treatment Standard (Average x VF) (ppm)
NONWASTEWATERS				
Volatile Organics (8240)				
K085 Benzene	Hexachlorobenzene	1.6	2.8	4.4
Chlorobenzene	Hexachlorobenzene	1.6	2.8	4.4
K105 Benzene	Hexachlorobenzene	1.6	2.8	4.4
Chlorobenzene	Hexachlorobenzene	1.6	2.8	4.4
Semivolatile Organics (8270)				
K042 o-Dichlorobenzene	Hexachlorobenzene	1.6	2.8	4.4
p-Dichlorobenzene	Hexachlorobenzene	1.6	2.8	4.4
Pentachlorobenzene	Hexachlorobenzene	1.6	2.8	4.4
1,2,4-Trichlorobenzene	Hexachlorobenzene	1.6	2.8	4.4
1,2,4,5-Tetrachlorobenzene	Hexachlorobenzene	1.6	2.8	4.4
K085 o-Dichlorobenzene	Hexachlorobenzene	1.6	2.8	4.4
m-Dichlorobenzene	Hexachlorobenzene	1.6	2.8	4.4
p-Dichlorobenzene	Hexachlorobenzene	1.6	2.8	4.4
Pentachlorobenzene	Hexachlorobenzene	1.6	2.8	4.4
1,2,4-Trichlorobenzene	Hexachlorobenzene	1.6	2.8	4.4
1,2,4,5-Tetrachlorobenzene	Hexachlorobenzene	1.6	2.8	4.4
Hexachlorobenzene	Hexachlorobenzene	1.6	2.8	4.4
K105 o-Dichlorobenzene	Hexachlorobenzene	1.6	2.8	4.4
p-Dichlorobenzene	Hexachlorobenzene	1.6	2.8	4.4
2-Chlorophenol	Hexachlorobenzene	1.6	2.8	4.4
Phenol	Hexachlorobenzene	1.6	2.8	4.4
2,4,5-Trichlorophenol	Hexachlorobenzene	1.6	2.8	4.4
2,4,6-Trichlorophenol	Hexachlorobenzene	1.6	2.8	4.4
PCBs (8080)				
K085 Aroclor 1016	Methoxychlor	0.33	2.8	0.92
Aroclor 1221	Methoxychlor	0.33	2.8	0.92
Aroclor 1232	Methoxychlor	0.33	2.8	0.92
Aroclor 1242	Methoxychlor	0.33	2.8	0.92
Aroclor 1248	Methoxychlor	0.33	2.8	0.92
Aroclor 1254	Methoxychlor	0.65	2.8	1.8
Aroclor 1260	Methoxychlor	0.65	2.8	1.8

Table 6-3

CALCULATION OF TREATMENT STANDARDS FOR HALOGENATED PESTICIDES AND CHLOROBENZENES - GROUP 3 (CHLOROPHENOXYACETIC ACIDS AND DERIVATIVES)

Waste Code	BDAT #	Constituent	Detection Status in Untreated or Treated Waste (Y or N)	Detection Limit (ppm)	Detection Limit Taken From Test #(s)*	Matrix Spike Recovery (%)	Recovery Data Transferred From (BDAT #/Test #)*	Accuracy Correction Factor	Corrected Detection Limit (ppm)	Variability Factor	Treatment Standard (ppm)
NONWASTEWATERS											
D016	192	2,4-Dichlorophenoxyacetic acid	Y	0.2	13	20	192/13	5	1	10.13	10
D017	193	2,4,5-TP (Silvex)	N	0.155	13	20	192/13	5	0.775	10.13	7.9

* Treatment test number is indicated in Table 4-1.

Table 6-4

CALCULATION OF TREATMENT STANDARDS FOR HALOGENATED PESTICIDES AND CHLOROBENZENES - GROUP 4 (CHLORINATED DIPHENYLS)

Waste Code	BDAT #	Constituent	Detection Status in Untreated or Treated Waste (Y or N)	Detection Limit (ppm)	Detection Limit Taken From Test #(s)*	Matrix Spike Recovery (%)	Recovery Data Transferred From (BDAT #/Test #)*	Accuracy Correction Factor	Corrected Detection Limit (ppm)	Variability Factor	Treatment Standard (ppm)
NONWASTEWATERS											
D014	190	Methoxychlor	Y	0.013	13	20	190/13	5	0.07	2.8	0.18

* Treatment test number is indicated in Table 4-1.

Table 6-5

CALCULATION OF TREATMENT STANDARDS FOR HALOGENATED PESTICIDES AND CHLOROBENZENES - GROUP 5 (CHLORINATED ALIPHATICS)

Waste Code	BDAT #	Constituent	Detection Status in Untreated or Treated Waste (Y or N)	Detection Limit (ppm)	Detection Limit Taken From Test #(s)*	Matrix Spike Recovery (%)	Recovery Data Transferred From (BDAT #/Test #)*	Accuracy Correction Factor	Corrected Detection Limit (ppm)	Variability Factor	Treatment Standard (ppm)
NONWASTEWATERS											
D013	176	gamma-BHC (Lindane)	N	0.0066	13,14	28	186/13	3.57	0.02	2.8	0.066

* Treatment test number is indicated in Table 4-1.

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14. U.S. EPA. 1987. U.S. Environmental Protection Agency. Onsite Engineering Report of Treatment Technology Performance and Operation: Incineration of K024 Waste at the U.S. Environmental Protection Agency Combustion Research Facility. 1987. Washington, D.C.: U.S. Environmental Protection Agency.

15. U.S. EPA. 1987. U.S. Environmental Protection Agency. Onsite Engineering Report of Treatment Technology Performance and Operation for Incineration of K037 Waste at the Combustion Research Facility. November 16, 1987. Washington, D.C.: U.S. Environmental Protection Agency.

16. U.S. EPA. 1988. U.S. Environmental Protection Agency. Onsite Engineering Report of Treatment Technology Performance and Operation for Amoco Oil Company, Whiting, Indiana. February 29, 1988. Washington, D.C.: U.S. Environmental Protection Agency.

17. U.S. EPA. 1990. Final Best Demonstrated Available Technology (BDAT) Background Document for U and P Wastes and Multi-Source Leachate (F039), Volume A. May, 1990. Washington, D.C.: U.S. Environmental Protection Agency.

18. U.S. EPA. 1988. U.S. Environmental Protection Agency. Onsite Engineering Report of Treatment Technology Performance and Operation for Incineration of K087 Waste at the Combustion Research Facility, Jefferson, Arkansas. February 22, 1988. Washington, D.C.: U.S. Environmental Protection Agency.

19. U.S. EPA. 1988. U.S. Environmental Protection Agency. Onsite Engineering Report for John Zink Company for K101. April 25, 1988. Washington, D.C.: U.S. Environmental Protection Agency.

20. U.S. EPA. 1988. U.S. Environmental Protection Agency. Onsite Engineering Report for John Zink Company for K102. April 25, 1988. Washington, D.C.: U.S. Environmental Protection Agency.

21. U.S. EPA. 1988. U.S. Environmental Protection Agency. Onsite Engineering Report of Treatment Technology Performance and Operation for Incineration for ENSCO, El Dorado, Arkansas. December, 1988. Washington, D.C.: U.S. Environmental Protection Agency.

22. U.S. EPA. 1987. U.S. Environmental Protection Agency. Onsite Engineering Report of Treatment Performance and Operation for Incineration of K015 Waste at the John Zink Company Test Facility. December 4, 1987. Washington, D.C.: U.S. Environmental Protection Agency.

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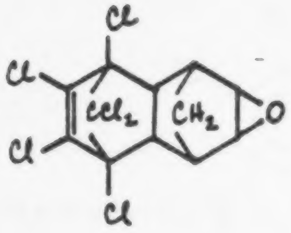
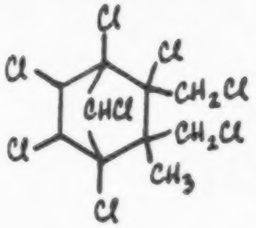
APPENDIX A

CHEMICAL STRUCTURES OF WASTE CONSTITUENTS INCLUDED IN THIS DOCUMENT

Halogenated Pesticides and Chlorobenzenes
Group 1

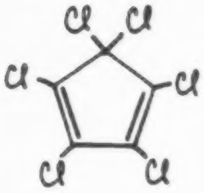


D012 Endrin >0.02 mg/l

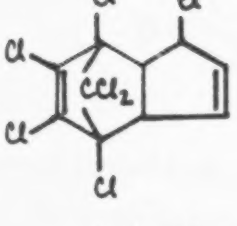


D015 Toxaphene >0.5 mg/l

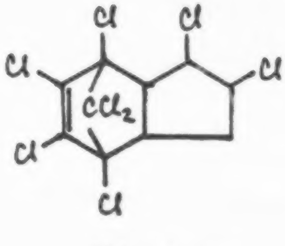
(also regulated in K041 and K098)



Hexachlorocyclopentadiene
(regulated in K032, K033,
K034, and K097)

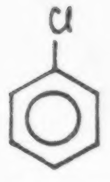


Heptachlor
(regulated in K032
and K097)



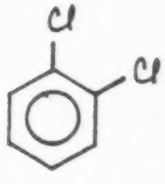
Chlordane
(regulated in K032
and K097)

Halogenated Pesticides and Chlorobenzenes
Group 2



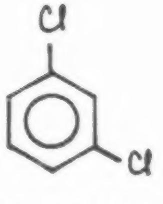
Chlorobenzene

(regulated in K085 and K105)



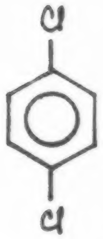
1,2- Dichlorobenzene

(regulated in K042, K085, and K105)



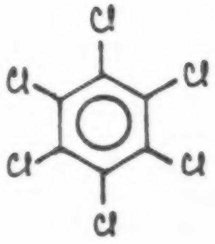
1,3- Dichlorobenzene

(regulated in K042, K085, and K105)



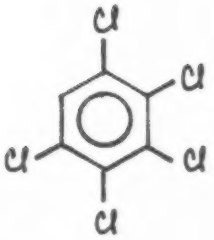
1,4-Dichlorobenzene

(regulated in K042, K085, and K105)



Hexachlorobenzene

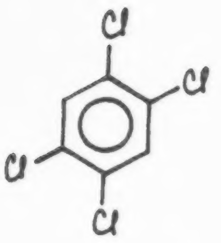
(regulated in K042 and K085)



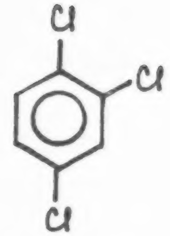
Pentachlorobenzene

(regulated in K042 and K085)

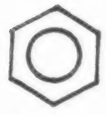
Halogenated Pesticides and Chlorobenzenes
Group 2 (Continued)



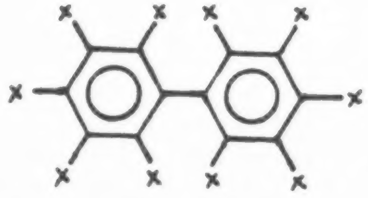
1,2,4,5-Tetrachlorobenzene
(regulated in K042 and K085)



1,2,4-Trichlorobenzene
(regulated in K042 and K085)



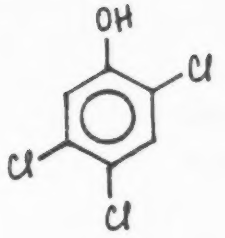
Benzene
(regulated in K085 and K105)



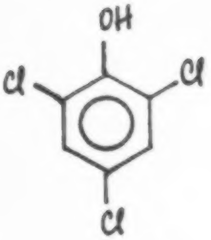
x = H or Cl

Polychlorinated biphenyls; PCBs
(regulated in K085)

Halogenated Pesticides and Chlorobenzenes
Group 2 (Continued)

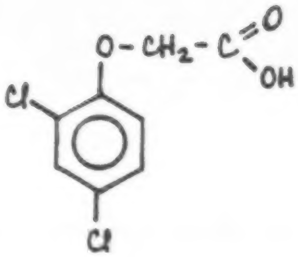


2,4,5- Trichlorophenol
(regulated in K105)

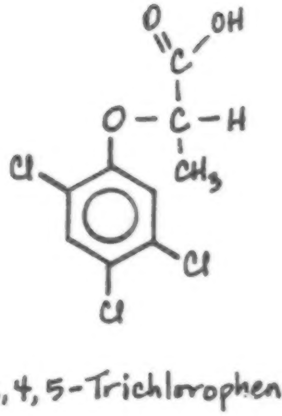


2,4,6- Trichlorophenol
(regulated in K105)

Halogenated Pesticides and Chlorobenzenes
Group 3

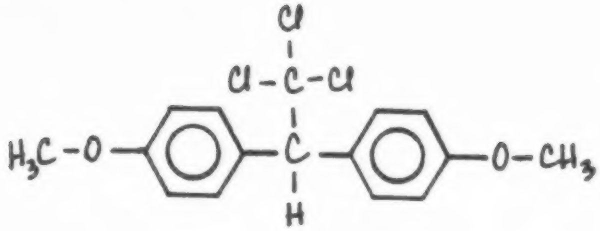

O - CH₂ - C=O
OH
Cl
Cl

D016 2,4-Dichlorophenoxyacetic acid >10.0 mg/l


O
OH
C
O - C - H
CH₃
Cl
Cl
Cl

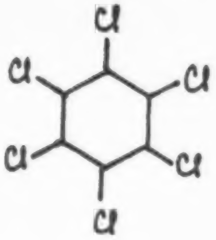
D017 2-(2,4,5-Trichlorophenoxy) propionic acid >1.0 mg/l

Halogenated Pesticides and Chlorobenzenes
Group 4


Cl
Cl
Cl
C
C
H
H3C-O
O-CH3

D014 Methoxychlor >10.0 mg/L

Halogenated Pesticides and Chlorobenzenes
Group 5


Cl
Cl
Cl
Cl
Cl
Cl

D013 Lindane >0.4 mg/l

APPENDIX B

SUMMARY OF TREATMENT PERFORMANCE DATA FOR CONSTITUENTS REGULATED IN WASTEWATER FORMS OF HALOGENATED PESTICIDE AND CHLOROBENZENE K AND D WASTES

Source: Reference 17.

Aroclor 1016. The data available for aroclor 1016 were compiled from the NPDES database and are presented in Table 4-157. The technology for which data were available was full-scale BT. The effluent concentrations for all documented data ranged from 0.5 ppb to 4.033 ppb.

BDAT for Aroclor 1016 is being promulgated as proposed and is identified as biological treatment (BT). Biological treatment was selected as BDAT since it represents full-scale data and is the only demonstrated technology for which the Agency has data. The BDAT treatment standard for Aroclor 1016 was calculated using the effluent concentration of 0.911 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for Aroclor 1016 (0.013 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-157
WASTEWATER TREATMENT PERFORMANCE DATA
FOR AROCLOR 1016

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		NY0007129			5	0.500			NPDES
		LA0066214			15	1.000			NPDES
		LA0065501			6	0.500			NPDES
		TN0001520			3	4.033			NPDES
		NY0007129			3	0.500			NPDES
* BT	Full	LA0038245			37	0.911			NPDES *

* Data used in developing proposed standard.

Aroclor 1221. The data available for aroclor 1221 were compiled from the NPDES database and are presented in Table 4-158. The technology for which data were available was full-scale BT. The effluent concentrations for all documented data ranged from 0.13 ppb to 15.3 ppb.

BDAT for Aroclor 1221 is being promulgated as proposed and is identified as biological treatment (BT). Biological treatment was selected as BDAT since it represents full-scale data and is the only demonstrated technology for which the Agency has data. The BDAT treatment standard for Aroclor 1221 was calculated using the effluent concentration of 1.018 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for Aroclor 1221 (0.014 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-158
WASTEWATER TREATMENT PERFORMANCE DATA
FOR AROCLOR 1221

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		LA0065501			6	0.130			NPDES
		LA0058882			33	15.300			NPDES
		LA0058882			32	15.000			NPDES
		NY0007129			5	0.500			NPDES
		NY0007129			3	0.500			NPDES
* BT	Full	LA0038245			39	1.018			NPDES *

* Data used in developing proposed standard.

Aroclor 1232. The data available for aroclor 1232 were compiled from the NPDES database and are presented in Table 4-159. The technology for which data were available was full-scale BT. The effluent concentrations of all documented data ranged from 0.5 ppb to 15.3 ppb.

BDAT for Aroclor 1232 is being promulgated as proposed and is identified as biological treatment (BT). Biological treatment was selected as BDAT because of since it represents full-scale data and is the only demonstrated technology for which the Agency has data. The BDAT treatment standard for Aroclor 1232 was calculated using the effluent concentration of 0.915 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for Aroclor 1232 (0.013 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-159
WASTEWATER TREATMENT PERFORMANCE DATA
FOR AROCLOR 1232

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		LA0058882			33	15.300			NPDES
		LA0058882			32	15.000			NPDES
		LA0065501			6	0.500			NPDES
		NY0007129			3	0.500			NPDES
		NY0007129			5	0.500			NPDES
* BT	Full	LA0038245			39	0.915			NPDES *

* Data used in developing proposed standard.

Aroclor 1242. The data available for aroclor 1242 were compiled from the NPDES database and are presented in Table 4-160. The technology for which data were available was full-scale BT. The effluent concentrations of all documented data ranged from 0.5 ppb to 15.3 ppb.

BDAT for Aroclor 1242 is being promulgated as proposed and is identified as biological treatment (BT). Biological treatment was selected as BDAT since it represents full-scale data and is the only demonstrated technology for which the Agency has data. The BDAT treatment standard for Aroclor 1242 was calculated using the effluent concentration of 1.186 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for Aroclor 1242 (0.017 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-160
WASTEWATER TREATMENT PERFORMANCE DATA
FOR AROCLOR 1242

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		LA0065501			6	0.500			NPDES
		LA0058882			31	12.260			NPDES
		NY0007129			3	0.593			NPDES
		NY0202037			29	0.500			NPDES
		NY0007226			7	0.623			NPDES
		LA0058882			33	15.300			NPDES
		NY0007129			5	0.612			NPDES
		NY0000566			12	1.433			NPDES
* BT	Full	LA0038245			39	1.186			NPDES *

* Data used in developing proposed standard.

__Aroclor 1248__. The data available for aroclor 1248 were compiled from the NPDES database and are presented in Table 4-161. The technology for which data were available was full-scale BT. The effluent concentrations for all documented data ranged from 0.5 ppb to 15.3 ppb.

BDAT for Aroclor 1248 is being promulgated as proposed and is identified as biological treatment (BT). Biological treatment was selected as BDAT since it represents full-scale data and is the only demonstrated technology for which the Agency has data. The BDAT treatment standard for Aroclor 1248 was calculated using the effluent concentration of 0.928 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for Aroclor 1248 (0.013 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-161
WASTEWATER TREATMENT PERFORMANCE DATA
FOR AROCLOR 1248

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		NY0007129			3	0.500			NPDES
		LA0058882			33	15.300			NPDES
		LA0058882			31	12.260			NPDES
		LA0065501			6	0.920			NPDES
		NY0000566			12	1.433			NPDES
		NY0007129			5	0.500			NPDES
* BT	Full	LA0038245			39	0.928			NPDES *

* Data used in developing proposed standard.

Aroclor 1254. The data available for aroclor 1254 were compiled from the NPDES and WERL databases and are presented in Table 4-162. The technologies for which data are available include AFF and BT. The treatment performance data represent bench- and full-scale studies. Resulting effluent concentrations ranged from 0.36 ppb to 15.3 ppb.

BDAT for Aroclor 1254 is being promulgated as proposed and is identified as biological treatment (BT). Biological treatment was selected as BDAT since it represents full-scale data and was preferred over bench-scale aerobic fixed film (AFF) data. The effluent concentrations achieved by AFF support the effluent concentration achieved by biological treatment. The BDAT treatment standard for Aroclor 1254 was calculated using the effluent concentration of 0.967 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for Aroclor 1254 (0.014 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-162
WASTEWATER TREATMENT PERFORMANCE DATA
FOR AROCLOR 1254

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		LA0058882			31	12.260			NPDES
		LA0065501			6	1.000			NPDES
		NY0007129			3	0.667			NPDES
		LA0058882			33	15.300			NPDES
		NY0007129			5	1.000			NPDES
AFF	Bench	70A		100-1000	19	11.000		98.9	WERL
AFF	Bench	70A		0-100	17	0.360		64	WERL
* BT	Full	LA0038245			39	0.967			NPDES *

* Data used in developing proposed standard.

Aroclor 1260. The data available for aroclor 1260 were compiled from the NPDES and WERL databases and are presented in Table 4-163. The technologies for which data are available include full-scale BT and Sed. The resulting effluent concentrations ranged from 0.028 ppb to 15.3 ppb.

BDAT for Aroclor 1260 is being promulgated as proposed and is identified as biological treatment (BT). Biological treatment was selected as BDAT since it represents full-scale data from a demonstrated technology. Although Sed data were also available, this technology alone is not considered applicable for the treatment of organics and therefore was not considered for BDAT. The BDAT treatment standard for Aroclor 1260 was calculated using the effluent concentration of 0.967 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for Aroclor 1260 (0.014 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-163
WASTEWATER TREATMENT PERFORMANCE DATA
FOR AROCLOR 1260

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		IN0053384			1	0.500			NPDES
		IN0053384			43	0.560			NPDES
		PA0026662			2	0.500			NPDES
		LA0058882			33	15.300			NPDES
		NY0007129			5	1.000			NPDES
		LA0058882			31	12.260			NPDES
		LA0065501			6	1.000			NPDES
		NY0007129			3	0.833			NPDES
		IN0053384			1	0.500			NPDES
* BT	Full	LA0038245			39	0.967			NPDES *
Sed	Full	981E		0-100	5	0.028		52	WERL

* Data used in developing proposed standard.

Benzene (U019). Several sources of wastewater treatment performance data were available for benzene, including data from the ITD, BDAT, and WERL databases as well as literature PACT^{R} data. These data are presented in Table 4-5. Technologies for which data are available include aerobic lagoons (AL), aerobic lagoons followed by activated sludge (AL+AS), API oil/water separation followed by dissolved air flotation and activated sludge (API+DAF+AS), AS, AS+Fil, air stripping (AirS), air stripping followed by granular activated carbon, (AirS+GAC), GAC, liquid, liquid extraction (LL), liquid, liquid extraction followed by steam stripping (LL+SS), liquid, liquid extraction followed by steam stripping and activated carbon (LL+SS+AC), PACT^{R}, RO, SS, trickling filter (TF), trickling filter followed by activated sludge (TF+AS), and WOx. The treatment performance data represent bench- and full-scale studies.

The treatment performance data available from the ITD database were used for setting the proposed and promulgated BDAT standard for this constituent for the following reasons:

(1) The ITD data represent treatment performance data from the OCPSF sampling episodes. The data collected by ITD include long-term sampling of several industries. These data are therefore a good reflection of the total organic chemical industry and can adequately represent a wastewater of unknown characteristics.

(2) The ITD data were carefully screened prior to inclusion in the OCPSF database. These data were used in determining an ITD promulgated limit.

(3) A promulgated ITD limit represents data that have undergone both EPA and industry review and acceptance.

BDAT for benzene is being promulgated as proposed and is identified as steam stripping (SS). The BDAT treatment standard was calculated using the ITD median long-term average of 10 ppb and the ITD Option 1 variability factor. The calculation of the resulting BDAT treatment standard for benzene (0.14 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-5
WASTEWATER TREATMENT PERFORMANCE DATA
FOR BENZENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AL	Bench	371D		1000-10000		60.000		98	WERL
AL	Full	6B		100-1000	2	10.000		98.9	WERL
AL	Full	1B		100-1000	6	10.000		94.4	WERL
AL	Full	6B		100-1000	2	10.000		92.3	WERL
AL+AS	Full	233D		10000-100000	21	13.000		99.9	WERL
API+DAF+AS	Full	1482D		1000-10000	4	3.700		99.96	WERL
AS	Full	6B		100-1000	7	10.000		98.8	WERL
AS	Bench	200B		100-1000	16	0.800		99.3	WERL
AS	Bench	200B		100-1000	8	1.000		99.83	WERL
AS	Full	1B		100-1000	6	2.000		99	WERL
AS	Full	6B		100-1000	22	30.000		91.7	WERL
AS	Full	1B		100-1000	6	1.000		99.55	WERL
AS	Full	6B		100-1000	14	10.000		95.7	WERL
AS	Full	6B		100-1000	3	10.000		95.6	WERL
AS	Full	1B		100-1000	6	2.000		98.9	WERL
AS	Bench	202D		100000-1000000		40.000		99.97	WERL
AS	Full	6B		1000-10000	3	10.000		99.09	WERL
AS	Full	6B		1000-10000	27	11.000		99.8	WERL
AS	Full	6B		1000-10000	3	10.000		99.71	WERL
AS	Full	6B		0-100	28	10.000		89.6	WERL
AS	Bench	200B		0-100	16	0.500		97.8	WERL
AS	Full	6B		10000-100000	15	10.000		99.97	WERL
AS	Full	234A		100-1000		0.600		99.83	WERL
AS	Full	201B		0-100	10	6.000		81	WERL
AS	Full	1B		0-100	6	16.000		84	WERL
AS	Pilot	206B		0-100	20	0.200		99.73	WERL
AS	Full	234A		0-100		0.700		97.4	WERL
AS+Fil	Full	6B		100000-1000000	3	20.000		99.99	WERL
AirS	Bench	1328E		10000-100000	5	9300.000		90	WERL
AirS	Full	322B		100-1000	22	0.440		99.74	WERL
AirS	Pilot	224B		100-1000	1	0.500		99.67	WERL
AirS	Full	322B		1000-10000	19	52.000		98.7	WERL
AirS	Pilot	1362E		100-1000	3	1.000		99.09	WERL
AirS+GAC	Full	229A		0-100	19	1.000		90.9	WERL

TABLE 4-5 (Continued)
WASTEWATER TREATMENT PERFORMANCE DATA FOR BENZENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
GAC	Full	245B		1000-10000	1	10.000		99.28	WERL
LL	Full	K104	5	4500-320000	5	35600.000	76.0		BDAT
LL	Full	K103	5	32000-81000	5	3560.000	76.0		BDAT
LL+SS	Full	K103/K104	5	4500-320000	5	5.600	76.0		BDAT
LL+SS+AC	Full	K103/K104	5	4500-320000	4	19.000	76.0		BDAT
PACT	Bench	242E		0-100		5.000		83	WERL
PACT	Bench	200B		100-1000	12	0.700		99.34	WERL
PACT	Bench	Zimpro		290	1	1.000		99.7	WAO
PACT	Bench	Zimpro		29	1	5.000		83	WAO
RO	Full	250B		1000-10000		140.000		92.2	WERL
RO	Full	250B		0-100		3.800		95.1	WERL
RO	Pilot	323B		0-100	1	32.000		19	WERL
RO	Pilot	250B		100-1000		50.000		78	WERL
RO	Full	250B		100-1000		67.000		92.7	WERL
* SS	Full	0415	10	22300-48100	4	38.800			ITD-L *
* SS	Full	2680	10	34693-147212	10	10.000			ITD-L *
* SS	Full	1494	10	239-2008310	13	44.800			ITD-L *
* SS	Full	0415	10	274000-412000	3	200.300			ITD-L *
SS	Full	6B		100000-1000000	3	200.000		99.94	WERL
SS	Full	6B		100000-1000000	12	48.000		99.99	WERL
SS	Full	6B		10000-100000	2	10.000		99.97	WERL
SS	Full	6B		10000-100000	10	10.000		99.99	WERL
SS	Full	251B		100-1000	10	10.000		96.3	WERL
TF	Full	1B		0-100	5	1.000		97.5	WERL
TF+AS	Full	6B		10000-100000	3	10.000		99.97	WERL
UF	Pilot	250B		1000-10000		230.000		78	WERL
WOx	Full	242E		1000-10000		29.000		99.64	WERL
WOx [B]	Bench	1054E		1000-10000		500.000		53	WERL
WOx [B]	Bench	1054E		100000-1000000		180000.000		82	WERL

* Data used in developing proposed standard.

gamma-BHC (U129). The data available for gamma-BHC were compiled from the NPDES and WERL databases and are presented in Table 4-140. Technologies for which data are available include AL, AS, BT, CAC, GAC, PACT®, and TF. The treatment performance data represent bench-, pilot-, and full-scale studies. The resulting effluent concentrations ranged from 0.006 ppb to 99 ppb.

BDAT for gamma-BHC is being promulgated as proposed and is identified as carbon adsorption. Granular activated carbon (GAC) was selected as BDAT since it represents full-scale data with a high influent concentration and a high removal efficiency. The BDAT treatment standard for gamma-BHC was calculated using the effluent concentration of 0.12 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for gamma-BHC (0.0017 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-140
WASTEWATER TREATMENT PERFORMANCE DATA
FOR GAMMA-BHC

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AL	Pilot	203A		0-100	11	7.0000		82	WERL
AL	Pilot	203A		0-100	11	22.0000		44	WERL
AS	Full	375E		0-100	7	0.1100		39	WERL
AS	Full	375E		0-100	7	0.0700		36	WERL
AS	Pilot	240A		0-100	11	27.0000		59	WERL
AS	Pilot	203A		0-100	11	31.0000		20	WERL
AS	Full	375E		0-100	7	0.0210		81	WERL
AS	Pilot	204A		0-100	8	26.0000		44	WERL
AS	Bench	200B		100-1000	13	99.0000		8.3	WERL
AS	Full	375E		0-100	7	0.0600		88	WERL
AS	Full	201B		0-100	2	1.0000		66	WERL
BT	Full	PA0026247			21	0.0061			NPDES
CAC	Pilot	203A		0-100	11	32.0000		18	WERL
* GAC	Full	257A		100-1000	1	0.1200		99.97	WERL *
PACT	Bench	200B		100-1000	17	8.0000		92.1	WERL
TF	Full	375E		0-100	7	0.0600		14	WERL
TF	Full	375E		0-100	7	0.1100		58	WERL
TF	Pilot	240A		0-100	10	37.0000		46	WERL
TF	Pilot	203A		0-100	11	34.0000		13	WERL

* Data used in developing proposed standard.

Chlordane (U036). The data available for chlordane were compiled from the NPDES database and literature data. These data are presented in Table 4-141. Technologies for which data are available include full-scale BT and pilot-scale Chred. The resulting effluent concentrations ranged from 0.01 ppb to 483 ppb, with a detection limit for chlordane established a 0.014 ppb. (See Table C-1, Appendix C.)

BDAT for chlordane is being promulgated as proposed and is identified as biological treatment (BT). Biological treatment was selected as BDAT since it represents full-scale treatment performance data and was the only technology for which the Agency had data. The BDAT treatment standard for chlordane was calculated using an effluent concentration of 0.2336 ppb (which represents the average of all BT effluent values; a value below the detection limit was set at the detection limit) and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for chlordane (0.0033 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-141
WASTEWATER TREATMENT PERFORMANCE DATA
FOR CHLORDANE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		CA0107611			1	0.1000			NPDES
		CA0048216			5	132.0000			NPDES
		CA0037681			13	0.1000			NPDES
		CA0037681			29	0.1000			NPDES
		OH0058874			5	0.0200			NPDES
		LA0058882			33	15.9000			NPDES
		LA0065501			6	0.5000			NPDES
		LA0058882			32	15.6000			NPDES
		PA0026531			29	483.4500			NPDES
		CA0038598			5	0.1000			NPDES
		CA0048194			5	0.3420			NPDES
		CA0107417			6	0.0802			NPDES
* BT	Full	CA0108031			1	0.0100			NPDES *
* BT	Full	LA0038245			38	1.6500			NPDES *
* BT	Full	CA0107395			5	0.2360			NPDES *
* BT	Full	CA0048160			3	0.0100			NPDES *
* BT	Full	TN0020711			22	0.0400			NPDES *
* BT	Full	CA0037737			4	0.0500			NPDES *
* BT	Full	CA0048143			2	0.1600			NPDES *
* BT	Full	CA0047996			1	0.0500			NPDES *
* BT	Full	CA0037494			2	0.1250			NPDES *
* BT	Full	CA0047881			1	0.0500			NPDES *
* BT	Full	CA0047364			3	0.0502			NPDES *
* BT	Full	CA0022756			1	0.5000			NPDES *
* BT	Full	CA0110604			9	0.1000			NPDES *
Chred	Pilot			30	6	0.1000			ART

* Data used in developing proposed standard.

Chlorobenzene (U037). The data available for chlorobenzene were compiled from the WERL database, BDAT Solvents Rule data, and literature PACT® and WAO data. These data are presented in Table 4-11. Technologies for which data are available include aerobic fixed film (AFF), AL, AS, AirS, biological granular activated carbon columns (BGAC), BT, GAC, PACT®, RO, SS, and WOx. The treatment performance data represent bench-, pilot-, and full-scale studies. The resulting effluent concentrations ranged from 0.250 ppb to 1,550,000 ppb.

BDAT for chlorobenzene is being promulgated as proposed and is identified as biological treatment (BT). Biological treatment was selected as BDAT because it represents full-scale data developed from ITD sampling and was used as part of the BDAT Solvents Rule. The effluent concentration achievable by this technology is supported by similar effluent concentrations from the AS and PACT® treatment performance data. The BDAT treatment standard for chlorobenzene was calculated using the effluent concentration of 10 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for chlorobenzene (0.057 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-11
WASTEWATER TREATMENT PERFORMANCE DATA
FOR CHLOROBENZENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AFF	Bench	501A		0-100	9	1.000		90.7	WERL
AL	Bench	371D		1000-10000		160.000		94.7	WERL
AS	Bench	200B		100-1000	12	1.100		99.17	WERL
AS	Bench	200B		100-1000	6	1.300		99.81	WERL
AS	Full	975B		100-1000		6.000		94.6	WERL
AS	Full	6B		100-1000	4	10.000		98.9	WERL
AS	Bench	200B		0-100	8	0.200		99.23	WERL
AS	Full	975B		100-1000		10.000		94.6	WERL
AS	Full	975B		0-100		6.000		84	WERL
AS	Full	1B		100-1000	6	3.000		98.9	WERL
AS	Pilot	206B		100-1000	20	1.300		99.34	WERL
AS	Pilot	241B		100-1000	5	4.000		98.6	WERL
AS	Full	975B		100-1000		12.000		97.8	WERL
AirS	Bench	1328E		1000-10000	5	1800.000		77	WERL
AirS	Bench	1328E		10000-100000	5	3300.000		89	WERL
BGAC	Bench	501A		0-100	23	0.290		97.6	WERL
BT	Full	P206		929-49775	8	841.000			BDAT ‡
BT	Full	P246		10-3040	13	101.000			BDAT ‡
BT	Full	P263		443-832	3	504.000			BDAT ‡
BT	Full	REF4		1900	1	12.000			BDAT ‡
* BT	Full	P202		79-429	20	10.000			BDAT ‡ *
BT+AC	Full	P246		10-7200	16	30.000			BDAT ‡
GAC	Full	245B		100-1000	1	10.000		96.6	WERL
GAC	Full	245B		1000-10000	1	10.000		99.7	WERL
GAC	Full	237A		1000-10000	1	10.000		99.17	WERL
GAC	Full	1421D		0-100		0.250		56	WERL
PACT	Full	6B		1000-10000	4	10.000		99.38	WERL
PACT	Bench	200B		100-1000	11	0.800		99.37	WERL
PACT	Bench	242E		0-100		5.000		84	WERL
PACT	Bench	Zimpro		31	1	5.000		84	WAO
RO	Pilot	323B		0-100	1	12.000		50	WERL
RO	Full	250B		0-100		4.000		53	WERL
RO	Full	250B		1000-10000		120.000		91.6	WERL
SS	Full	251B		100-1000	10	10.000		97.4	WERL
WOx	Bench	Zimpro		5535000	1	1550000.000		72	WAO
WOx	Bench	Zimpro		792000	1	61000.000		92.3	WAO

‡ ITD data presented in the BDAT Solvents Rule F001-F005 Background Document.

* Data used in developing proposed standard.

2-Chlorophenol (U048). The data available for 2-chlorophenol were compiled from the WERL database and literature PACT® and WAO data. These data are presented in Table 4-72. Technologies for which data are available include AL, AS, PACT®, rotating biological contactors (RBC), SCOx, and WOx. The treatment performance data represent bench-, pilot-, and full-scale studies. The resulting effluent concentrations ranged from 0.05 ppb to 39,000 ppb.

BDAT for 2-chlorophenol is being promulgated as proposed and is identified as activated sludge biological treatment (BT). Activated sludge was selected as BDAT because it represents full-scale treatment with high influent concentrations and a high removal efficiency. The BDAT treatment standard for 2-chlorophenol was calculated using the effluent concentration of 10 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for 2-chlorophenol (0.044 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-72
WASTEWATER TREATMENT PERFORMANCE DATA
FOR 2-CHLOROPHENOL

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AL	Pilot	192D		100-1000		10.000		95	WERL
AL	Pilot	192D		1000-10000		10.000		99.07	WERL
* AS	Full	6B		10000-100000	2	10.000		99.93	WERL *
AS	Pilot	192D		100-1000		10.000		95	WERL
AS	Full	6B		100-1000	3	10.000		97.2	WERL
AS	Pilot	192D		1000-10000		10.000		99.07	WERL
PACT	Bench	Zimpro		31.9	1	0.050		99.84	WAO
PACT	Full	6B		10000-100000	10	93.000		99.78	WERL
RBC	Pilot	192D		100-1000		10.000		95	WERL
SCOx	Pilot	65D		>1000000		36.000		99.99	WERL
WOx	Bench	Zimpro		12410000	1	15000.000		99.88	WAO
WOx [B]	Bench	236A		>1000000	1	17000.000		99.86	WERL
WOx [B]	Bench	1101D		>1000000		39000.000		99.22	WERL

* Data used in developing proposed standard.

m-Dichlorobenzene (U071). The data available for m-dichlorobenzene were compiled from the WERL database and are presented in Table 4-77A. In addition, leachate treatment performance data submitted by industry just prior to proposal are presented in Table 4-77B. Technologies for which data are available include aerobic fixed film (AFF), AS, AirS, BGAC, GAC, PACT^{R}, RO, and BT. The treatment performance data represent bench-, pilot-, and full-scale studies. The resulting effluent concentrations ranged from 0.160 ppb to 3,300 ppb.

At proposal, BDAT for m-dichlorobenzene was identified as biological treatment and the treatment standard was based on an effluent concentration of 3.6 ppb from activated sludge (AS). Between proposal and promulgation, EPA evaluated the industry-submitted leachate data available for m-dichlorobenzene. Since this data for biological treatment (BT) showed substantial treatment of m-dichlorobenzene and showed average leachate effluent values greater than that of activated sludge, these data were used to calculate the promulgated standard. Therefore, BDAT for m-dichlorobenzene is biological treatment.

The BDAT treatment standard for m-dichlorobenzene was calculated using the effluent concentration of 10 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for m-dichlorobenzene (0.036 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-77A
WASTEWATER TREATMENT PERFORMANCE DATA FOR m-DICHLOROBENZENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AFF	Bench	501A		0-100	34	7.100		28	WERL
AS	Full	1587E		0-100		0.270		77	WERL
* AS	Full	975B		100-1000		3.600		99.14	WERL *
AS	Pilot	241B		100-1000	11	41.000		89	WERL
AS	Full	1B		100-1000	2	5.000		98	WERL
AS	Full	975B		0-100		1.200		93.3	WERL
AS	Bench	202D		10000-100000		340.000		99.51	WERL
AirS	Bench	1328E		10000-100000	5	3300.000		89	WERL
BGAC	Bench	501A		0-100	34	0.500		94.9	WERL
GAC	Full	1421D		0-100		0.290		80	WERL
PACT	Bench	975B		0-100		2.000		83	WERL
PACT	Full	6B		100-1000	10	25.000		96.9	WERL
RO	Pilot	323B		0-100	1	9.000		66	WERL
RO	Pilot	180A		0-100		0.160		69	WERL

* Data used in developing proposed standard.

TABLE 4-77B
INDUSTRY-SUBMITTED TREATMENT PERFORMANCE DATA FOR m-DICHLOROBENZENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
BT		DOW	10	46-205	3	10.000		91.24	LEACHATE

o-Dichlorobenzene (U070). The data available for o-dichlorobenzene were compiled from the WERL database, BDAT Solvents Rule data, and literature WAO data. These data are presented in Table 4-78. Technologies for which data are available include AFF, AL, AS, AirS, BGAC, BT, GAC, PACT®, RBC, RO, and WOx. The treatment performance data represent bench-, pilot-, and full-scale studies. The resulting effluent concentrations ranged from 0.09 ppb to 2,017,000 ppb.

BDAT for o-dichlorobenzene is being promulgated as proposed and is identified as biological treatment (BT). Biological treatment was selected as BDAT because it represents full-scale data developed from ITD sampling and was used as part of the BDAT Solvents Rule. The effluent concentration achievable by this technology is supported by similar effluent concentrations from the WERL activated sludge treatment performance data. The BDAT treatment standard for o-dichlorobenzene was calculated using the effluent concentration of 16 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for o-dichlorobenzene (0.088 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-78
WASTEWATER TREATMENT PERFORMANCE DATA FOR o-DICHLOROBENZENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AFF	Bench	501A		0-100	25	0.380		96	WERL
AL	Pilot	192D		100-1000		10.000		97.7	WERL
AL	Pilot	192D		1000-10000		100.000		94.8	WERL
AL	Bench	371D		1000-10000		72.000		97.6	WERL
AS	Full	1B		100-1000	4	6.000		96	WERL
AS	Full	6B		1000-10000	3	52.000		98.5	WERL
AS	Pilot	192D		1000-10000		110.000		94.3	WERL
AS	Pilot	192D		100-1000		270.000		37	WERL
AS	Full	6B		100-1000	330	35.000		96.2	WERL
AS	Full	1B		100-1000	2	5.000		96.2	WERL
AS	Full	1B		0-100	3	2.000		94.3	WERL
AS	Full	6B		1000-10000	4	16.000		99.33	WERL
AS	Bench	200B		100-1000	14	8.000		92.7	WERL
AS	Full	1B		100-1000	5	10.000		91.7	WERL
AS	Full	1587E		0-100		1.200		79	WERL
AS	Bench	202D		10000-100000		50.000		99.94	WERL
AS	Pilot	241B		100-1000	10	25.000		93.2	WERL
AS	Bench	1050E		100-1000	5	1.600		99.6	WERL
AS	Full	375E		0-100	7	5.000		67	WERL
AS	Full	6B		100-1000	3	10.000		92.9	WERL
AS	Bench	1054E		100-1000		8.000		98.4	WERL
AirS	Bench	1328E		10000-100000	5	6200.000		74	WERL
AirS	Pilot	222B		0-100	1	0.500		83	WERL
BGAC	Bench	501A		0-100	34	0.310		96.8	WERL
BT	Full	P246		768-2801	14	596.000			BDAT ‡
* BT	Full	P202		1350-4387	4	16.000			BDAT ‡ *
BT	Full	P206		233-2333	10	88.000			BDAT ‡
BT+AC	Full	P246		768-3275	17	176.000			BDAT ‡
GAC	Full	245B		100-1000	1	10.000		98.9	WERL
GAC	Full	1421D		0-100		0.270		90	WERL
PACT	Bench	242E		0-100		5.000		83	WERL
PACT	Bench	200B		100-1000	14	2.900		97.5	WERL
PACT	Full	6B		1000-10000	10	88.000		98.5	WERL
PACT	Full	6B		100-1000	4	64.000		90	WERL
RBC	Pilot	192D		100-1000		10.000		97.7	WERL
RO	Pilot	323B		0-100	1	11.000		70	WERL
RO	Pilot	180A		0-100		0.090		92.5	WERL
WOx	Bench	Zimpro		590000	1	150000.000		74.6	WAO
WOx	Bench	Zimpro		6530000	1	2017000.000		69.1	WAO
WOx	Pilot	78D		>1000000		29000.000		98.7	WERL

‡ ITD data presented in the BDAT Solvents Rule F001-F005 Background Document.
* Data used in developing proposed standard.

p-Dichlorobenzene (U072). The data available for p-dichlorobenzene were compiled from the WERL database and literature WAO data. These data are presented in Table 4-79. Technologies for which data are available include AFF, AL, AS, AirS, BGAC, CAC, ChOx, GAC, PACT®, RBC, RO, and TF. The treatment performance data represent bench-, pilot, and full-scale studies. The resulting effluent concentrations ranged from 0.004 ppb to 3,600 ppb.

BDAT for p-dichlorobenzene is being promulgated as proposed and is identified as activated sludge biological treatment (AS). Activated sludge was selected as BDAT because it represents full-scale data with high influent concentrations and high removal efficiencies. The BDAT treatment standard for p-dichlorobenzene was calculated using an effluent concentration of 16.33 ppb (which represents an average of the data presented for the activated sludge technology in the high influent concentration ranges) and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for p-dichlorobenzene (0.090 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-79
WASTEWATER TREATMENT PERFORMANCE DATA FOR p-DICHLOROBENZENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AFF	Bench	501A		0-100	27	0.200		98.1	WERL
AL	Pilot	192D		0-100		10.000		88	WERL
AL	Pilot	203A		0-100	11	31.000		67	WERL
AL	Pilot	203A		0-100	11	12.000		87	WERL
AL	Pilot	192D		100-1000		10.000		90.5	WERL
AS	Full	1B		0-100	2	10.000		76	WERL
AS	Full	234A		0-100		0.500		81	WERL
AS	Pilot	241B		100-1000	4	10.000		90.7	WERL
* AS	Full	975B		1000-10000		12.000		99.63	WERL *
AS	Pilot	192D		100-1000		10.000		90.5	WERL
AS	Pilot	631D		0-100		0.004		99	WERL
AS	Pilot	631D		0-100		0.004		99	WERL
AS	Pilot	240A		100-1000	12	8.000		93.8	WERL
AS	Pilot	192D		0-100		10.000		88	WERL
AS	Full	234A		0-100		0.500		90	WERL
AS	Pilot	241B		100-1000	11	19.000		95.1	WERL
AS	Full	201B		0-100	2	6.000		79	WERL
AS	Full	1B		0-100	1	5.000		93.1	WERL
AS	Full	1B		0-100	1	8.000		83	WERL
AS	Pilot	203A		0-100	11	5.000		94.6	WERL
AS	Full	234A		0-100		0.500		91.7	WERL
* AS	Full	6B		100-1000	4	10.000		97	WERL *
AS	Full	975B		0-100		4.900		92.8	WERL
* AS	Full	975B		100-1000		27.000		96.6	WERL *
AirS	Bench	1328E		10000-100000	5	3600.000		90	WERL
BGAC	Bench	501A		0-100	34	0.270		97.5	WERL
CAC	Pilot	203A		0-100	11	66.000		29	WERL
ChOx	Bench	975B		0-100		5.000		91.1	WERL
GAC	Full	245B		100-1000	1	10.000		96	WERL
GAC	Full	1421D		0-100		0.200		92	WERL
PACT	Bench	975B		0-100		5.000		93.5	WERL
PACT	Bench	975B		0-100		5.000		92.3	WERL
PACT	Bench	Zimpro		36.6	1	0.015		99.96	WAO
RBC	Pilot	192D		0-100		10.000		88	WERL
RO	Pilot	180A		0-100		0.670		61	WERL
TF	Pilot	240A		100-1000	11	16.000		88	WERL
TF	Pilot	203A		0-100	11	58.000		38	WERL

* Data used in developing proposed standard.

2,4-Dichlorophenoxyacetic Acid (U240). The data available for 2,4-dichlorophenoxyacetic acid were compiled from the NPDES and BDAT databases and are presented in Table 4-154. Technologies for which data are available include full-scale BT and chlorination (ChOx(Cl)) as well as pilot-scale WOx+PACT[a]. The resulting effluent concentrations ranged from 0.1 ppb to 30,432 ppb.

BDAT for 2,4-dichlorophenoxyacetic acid is being promulgated as proposed and is identified as chlorination (ChOx(Cl)). ChOx(Cl) was selected as BDAT since it represents full-scale data developed for the BDAT program (K099) using BDAT standard procedures. The BDAT treatment standard for 2,4-dichlorophenoxyacetic acid was calculated using the effluent concentration of 51.5 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for 2,4-dichlorophenoxyacetic acid (0.72 ppm) is described in Section 6.0 and is shown in Table 6-10.

Biological treatment data were presented on 2,4-dichlorophenoxyacetic acid in the comments on the Third Third Rule. The Agency reviewed these data and found that the influent concentrations were low (i.e. between 3-6 ppb with one value at 320 ppb). The effluent concentrations were at a detection limit of 3 ppb. Since the data available to the Agency at proposal had higher influent concentrations, the Agency preferred to use these data instead of the data submitted in the comments on the Third Third Rule. These data were therefore not considered further for determination of BDAT.

Wastes which are believed to contain 2,4-dichlorophenoxyacetic acid salts and/or esters are required to meet the BDAT standards identified in the Final BDAT Background Document for Wastewater and Nonwastewater Forms of Organic U and P Wastes for Which a Method of Treatment Standard Has Been Set, Volume B (Reference 19).

TABLE 4-154
WASTEWATER TREATMENT PERFORMANCE DATA FOR 2,4-DICHLOROPHENOXYACETIC ACID

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		AR0038512			22	30431.800			NPDES
		AR0038512			20	13405.200			NPDES
		OH0058874			5	0.100			NPDES
BT	Full	LA0038245			37	910.030			NPDES
* ChOx(Cl)	Full	K099	20	26900	2	51.500	96		BDAT *
WOx + PACT	Pilot	Zimpro	30	28000-74000	3	323.330			WAO

* Data used in developing proposed standard.

Endrin (P051). The data available for endrin were compiled from the NPDES database and are presented in Table 4-148. The technology for which data were available was full-scale BT. The resulting effluent concentrations ranged from 0.0003 ppb to 94 ppb with a detection limit for endrin established at 0.006 ppb (see Table C-1, Appendix C).

BDAT for endrin is being promulgated as proposed and is identified as biological treatment (BT). Biological treatment was selected as BDAT since it represents full-scale data and is the only demonstrated technology for which the Agency has data. The BDAT treatment standard for endrin was calculated using an effluent concentration of 0.1992 ppb (which represents the average of all BT effluent values; a value below the detection limit was set at the detection limit) and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for endrin (0.0028 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-148
WASTEWATER TREATMENT PERFORMANCE DATA FOR ENDRIN

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		AR0037800			3	0.0200			NPDES
		AR0037800			46	20.0000			NPDES
		AR0037800			43	0.0200			NPDES
		CA0037681			29	0.2900			NPDES
		CA0038598			5	0.0180			NPDES
		AR0037800			39	0.0200			NPDES
		AR0037800			31	0.6600			NPDES
		CA0037681			13	0.1000			NPDES
		LA0058882			32	15.0000			NPDES
		CA0048194			5	0.0580			NPDES
		CA0048216			5	94.0000			NPDES
		CA0107417			6	0.0801			NPDES
		CA0107611			1	0.0200			NPDES
		LA0058882			33	15.3000			NPDES
		LA0065501			6	0.1000			NPDES
* BT	Full	CA0108031			1	0.0003			NPDES *
* BT	Full	CA0047996			1	0.0200			NPDES *
* BT	Full	CA0110604			9	0.0200			NPDES *
* BT	Full	CA0047364			3	0.0133			NPDES *
* BT	Full	CA0037737			4	0.0080			NPDES *
* BT	Full	CA0048143			2	0.1000			NPDES *
* BT	Full	CA0047881			1	0.2000			NPDES *
* BT	Full	CA0037494			2	0.0375			NPDES *
* BT	Full	CA0022756			1	0.5000			NPDES *
* BT	Full	LA0038245			38	1.0868			NPDES *

* Data used in developing proposed standard.

Heptachlor (P059). The data available for heptachlor were compiled from the NPDES and WERL databases and are presented in Table 4-150. Technologies for which data are available include AL, AS, BT, CAC, GAC, and TF. The treatment performance data represents pilot- and full-scale studies. The resulting effluent concentrations ranged from 0.01 ppb to 26 ppb with a detection limit for heptachlor established at 0.083 ppb (see Table C-1, Appendix C).

BDAT for heptachlor is being promulgated as proposed and is identified as carbon adsorption. Granular activated carbon (GAC) was selected as BDAT since it represents full-scale data with a high influent concentration and a high removal efficiency. The BDAT treatment standard for heptachlor was calculated using an effluent concentration of 0.083 ppb (which represents the detection limit) and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for heptachlor (0.0012 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-150
WASTEWATER TREATMENT PERFORMANCE DATA
FOR HEPTACHLOR

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		LA0058882			33	15.3000			NPDES
		LA0058882			32	15.0000			NPDES
		LA0065501			6	0.1000			NPDES
		PA0026531			29	22.4140			NPDES
		FL0021661			3	0.0430			NPDES
AL	Pilot	203A		0-100	11	13.0000		67	WERL
AL	Pilot	203A		0-100	11	13.0000		67	WERL
AS	Pilot	240A		0-100	13	25.0000		68	WERL
AS	Pilot	203A		0-100	11	13.0000		67	WERL
AS	Pilot	204A		0-100	8	2.3000		92.8	WERL
BT	Full	LA0038245			39	1.7590			NPDES
BT	Full	PA0026247			25	0.8470			NPDES
CAC	Pilot	203A		0-100	11	14.0000		64	WERL
* GAC	Full	237A		100-1000	1	0.0100		99.99	WERL *
TF	Pilot	203A		0-100	11	18.0000		54	WERL
TF	Pilot	240A		0-100	12	26.0000		67	WERL

* Data used in developing proposed standard.

Heptachlor Epoxide (P059). The data available for heptachlor epoxide were compiled from the NPDES database and are presented in Table 4-151A. The technology for which data were available was full-scale BT. The effluent concentrations of all the data presented ranged from 0.1 ppb to 16.5 ppb.

BDAT for heptachlor epoxide is being promulgated as proposed and is identified as biological treatment (BT). Biological treatment was selected as BDAT since it represents full-scale data and is the only demonstrated technology for which the Agency has data. The BDAT treatment standard for heptachlor epoxide was calculated using the effluent concentration of 1.1449 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for heptachlor epoxide (0.016 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-151A
WASTEWATER TREATMENT PERFORMANCE DATA
FOR HEPTACHLOR EPOXIDE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		LA0065501			6	0.1000			NPDES
		LA0058882			32	15.9000			NPDES
		LA0058882			33	16.5000			NPDES
* BT	Full	LA0038245			39	1.1449			NPDES *

* Data used in developing proposed standard.

Hexachlorobenzene (U127). The data available for hexachlorobenzene were compiled from the WERL database and are presented in Table 4-94. Technologies for which data are available include AS, AS+Fil, and GAC and the data are all from treatment at full-scale facilities. The resulting effluent concentrations ranged from 0.01 ppb to 20 ppb.

BDAT for hexachlorobenzene is being promulgated as proposed and is identified as activated sludge followed by filtration (AS+Fil). AS+Fil was selected as BDAT since it represents full-scale data with a high influent concentration and a high removal efficiency. The BDAT treatment standard for hexachlorobenzene was calculated using the effluent concentration of 10 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for hexachlorobenzene (0.055 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-94
WASTEWATER TREATMENT PERFORMANCE DATA FOR HEXACHLOROBENZENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AS	Full	375E		0-100	7	0.010		83	WERL
AS	Full	375E		0-100	7	0.010		94.4	WERL
* AS+Fil	Full	6B		100-1000	14	10.000		96.7	WERL *
GAC	Full	237A		0-100	1	20.000		38	WERL

* Data used in developing proposed standard.

TABLE 4-95
WASTEWATER TREATMENT PERFORMANCE DATA FOR HEXACHLOROBUTADIENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AS	Pilot	241B		100-1000	11	15.000		96.2	WERL
* AS+Fil	Full	6B		100-1000	2	10.000		92.8	WERL *
* AS+Fil	Full	6B		1000-10000	14	10.000		99.6	WERL *
GAC	Full	237A		100-1000	1	20.000		82	WERL

* Data used in developing proposed standard.

Hexachlorocyclopentadiene (U130). The data available for hexachlorocyclopentadiene were compiled from the NPDES database and literature WAO data. These data are presented in Table 4-96. The treatment technologies for which data are available include full-scale BT and bench-scale WOx. The effluent concentrations of all the data documented ranged from 0.2 ppb to 15,000 ppb.

BDAT for hexachlorocyclopentadiene is being promulgated as proposed and is identified as biological treatment (BT). Biological treatment was selected as BDAT since it represents full-scale treatment performance. The BDAT treatment standard for hexachlorocyclopentadiene was calculated using the effluent concentration of 10.263 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for hexachlorocyclopentadiene (0.057 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-96
WASTEWATER TREATMENT PERFORMANCE DATA
FOR HEXACHLOROCYCLOPENTADIENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		LA0065501			6	10.000			NPDES
		MI0025739			1	0.200			NPDES
		LA0066214			15	10.000			NPDES
		NY0107174			24	1.000			NPDES
* BT	Full	LA0038245			38	10.263			NPDES *
WOx	Bench	Zimpro		>10000000	1	15000.000		99.9	WAO

Methoxyclor (U247). The data available for methoxyclor were compiled from the WERL and NPDES databases and are presented in Table 4-152. Technologies for which data are available include full-scale BT and WOx. The resulting effluent concentrations ranged from 0.01 ppb to 53.652 ppb.

BDAT for methoxychlor is being promulgated as proposed and is identified as wet air oxidation (WOx). Wet air oxidation was selected as BDAT since it represents a full-scale demonstrated technology with substantial treatment for methoxyclor. In addition, the wet air oxidation data showed a high influent concentration. The BDAT treatment standard for methoxyclor was calculated using the effluent concentration of 18 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for methoxyclor (0.25 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-152
WASTEWATER TREATMENT PERFORMANCE DATA
FOR METHOXYCLOR

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
BT	Full	OH0058874			5	0.0100			NPDES
		WV0000108			14	53.6520			NPDES
* WOx	Full	78D		1000-10000		18.0000		99.8	WERL *

* Data used in developing proposed standard.

Pentachlorobenzene (U183). No wastewater treatment performance data were available for pentachlorobenzene from any of the examined sources. Treatment performance data were therefore transferred to this constituent from a constituent judged to be similar in elemental composition and functional groups within the structure of the chemical. For constituents represented by a U or P code, this means that constituents included in the same waste treatability group (see Appendix B) were candidates for transfer of data. Pentachlorobenzene is in treatability group III.A.2.c.(3)(b) and the constituent used to transfer treatment performance data from was hexachlorobenzene. The treatment performance data for hexachlorobenzene are presented in Table 4-94. Using a transfer from this constituent results in a BDAT for pentachlorobenzene of activated sludge followed by filtration and a BDAT treatment standard of 0.055 ppm as described in Section 6.0 and shown in Table 6-10.

Phenol (U188). Several sources of wastewater treatment performance data were available for phenol, including data from the ITD, BDAT, and WERL databases as well as literature WAO data. These data are presented in Table 4-109A. In addition, leachate treatment performance data submitted by industry just prior to proposal are presented in Table 4-109B. Technologies for which data are available include AL, API+DAF+AS, AS, ChOx, GAC, BT, LL, LL+SS, LL+SS+AC, PACT®, RBC, RO, SBR, SS, TF, WOx, AS+Fil, and Anff. The treatment performance data represent bench-, pilot-, and full-scale studies.

At proposal, BDAT for phenol was identified as biological treatment and the treatment standard was based on an ITD median long-term average effluent concentration of 10.363 ppb from the ITD database. Between proposal and promulgation, EPA evaluated the industry-submitted leachate data available for phenol. Since this data for biological treatment (BT) showed substantial treatment of phenol, these data were used to calculate the promulgated standards. Therefore, BDAT for phenol is biological treatment.

The BDAT treatment standard for phenol was calculated using the effluent concentration of 10 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for phenol (0.039 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-109A
WASTEWATER TREATMENT PERFORMANCE DATA FOR PHENOL

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AL	Pilot	203A		100-1000	11	84.000		33	WERL
AL	Pilot	203A		100-1000	11	18.000		86	WERL
AL	Full	6B		100-1000	3	11.000		90.8	WERL
AL	Pilot	192D		100-1000		10.000		98.99	WERL
API+DAF+AS	Full	1482D		100-1000	4	85.000		89.5	WERL
AS	Full	1B		100-1000	5	2.000		98.6	WERL
AS	Full	1B		0-100	6	26.000		63	WERL
AS	Bench	202D		100000-1000000		0.010		99.99	WERL
AS	Full	6B		100-1000	39	10.000		96.4	WERL
AS	Full	1B		100-1000	5	8.000		97.2	WERL
AS	Pilot	203A		100-1000	11	14.000		89	WERL
AS	Full	201B		100-1000	31	20.000		92.6	WERL
AS	Full	1B		100-1000	6	1.000		99.89	WERL
AS	Full	6B		10000-100000	3	10.000		99.94	WERL
AS	Full	1B		100-1000	6	61.000		92.4	WERL
AS	Full	1B		0-100	3	1.000		96.4	WERL
AS	Full	975B		1000-10000		6.600		99.87	WERL
AS	Full	1B		100-1000	5	1.000		99.33	WERL
AS	Bench	1054E		100000-1000000		0.250		99.88	WERL
AS	Pilot	240A		0-100	11	10.000		90	WERL
AS	Full	6B		100-1000	7	15.000		98	WERL
AS	Full	1122E		10000-100000		4000.000		95.2	WERL
AS	Full	6B		100-1000	3	120.000		97.9	WERL
AS	Pilot	241B		100-1000	4	8.000		97.2	WERL
AS	Full	6B		1000-10000	10	21.000		99.64	WERL
AS	Full	975B		100-1000		20.000		87	WERL
AS	Full	6B		100-1000	11	10.000		96.3	WERL
AS	Full	1B		100-1000	6	1.000		99.44	WERL
AS	Full	1B		0-100	6	1.000		98.3	WERL
AS	Full	6B		100-1000	3	10.000		98.6	WERL
AS	Pilot	226B		100000-1000000	6	500.000		99.95	WERL
AS	Full	975B		1000-10000		160.000		95	WERL
AS	Full	6B		100000-1000000	2	10.000		99.99	WERL
AS	Pilot	204A		100-1000	8	14.000		94.6	WERL
AS	Pilot	192D		100-1000		10.000		98.99	WERL
AS	Full	6B		1000-10000	4	56.000		96.9	WERL
AS	Bench	1054E		10000-100000		1000.000		95	WERL
AS	Full	6B		100000-1000000	13	10.000		99.99	WERL
AS	Full	1B		100-1000	6	25.000		94.4	WERL
AS+Fil	Full	6B		10000-100000	3	13.000		99.98	WERL
AS+Fil	Full	6B		100-1000	15	10.000		98	WERL

TABLE 4-109A (Continued)
WASTEWATER TREATMENT PERFORMANCE DATA FOR PHENOL

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AnFF	Pilot	231A		1000000		700.000		99.98	WERL
AnFF	Pilot	231A		1000000		30.000		99.99	WERL
AnFF	Bench	230A		100000-1000000		10.000		98.97	WERL
AnFF	Pilot	231A		100000-1000000		10.000		99.99	WERL
AnFF	Pilot	231A		100000-1000000		70.000		99.98	WERL
AnFF	Bench	230A		>1000000		1000.000		99.95	WERL
AnFF	Pilot	235D		100000-1000000		240.000		99.86	WERL
AnFFwGAC	Pilot	249D		1000000		50.000		99.99	WERL
CAC	Pilot	203A		100-1000	11	99.000		21	WERL
ChOx	Bench	975B		100-1000		16.000		93.3	WERL
ChOx	Bench	975B		100-1000		2.000		98.3	WERL
ChOx	Bench	975B		1000-10000		12.000		99.37	WERL
GAC	Bench	1054E		100-1000		10.000		99	WERL
GAC	Full	245B		100-1000	1	10.000		92.6	WERL
GAC	Full	237A		1000-10000	1	5.000		99.89	WERL
* BT	Full	1293	10	698564-978672	15	10.000			ITD-L *
LL	Full	K104	30	150000-300000	5	165000.000	21		BDAT
LL	Full	K103	30	1500000-3000000	5	84000.000	21		BDAT
LL+SS	Full	K103/K104	30	150000-3000000	5	2400.000	21		BDAT
LL+SS+AC	Full	K103/K104	30	150000-3000000	4	60.000	21		BDAT
PACT	Bench	190E		10000-100000		1.800		99.99	WERL
PACT	Bench	975B		1000-10000		2.000		99.96	WERL
PACT	Full	6B		1000-10000	3	30.000		98.6	WERL
PACT	Bench	975B		1000-10000		8.000		99.85	WERL
RBC	Pilot	603E		100000-1000000		1700.000		99.6	WERL
RBC	Pilot	192D		100-1000		10.000		98.99	WERL
RO	Full	250B		1000-10000		120.000		93.6	WERL
SBR	Pilot	1433D		10000-100000	16	1000.000		97.7	WERL
SBR	Pilot	227D		100000-1000000	1	1000.000		99.81	WERL
SBR	Bench	64D		100000-1000000		3000.000		99.63	WERL
SBRwPACT	Bench	64D		100000-1000000		1000.000		99.88	WERL
SExt	Pilot	1082E		>1000000		210000.000		95.4	WERL
SS	Pilot	1082E		100000-1000000		160.000		24	WERL
TF	Pilot	203A		100-1000	11	64.000		49	WERL
TF	Full	1B		100-1000	6	47.000		82	WERL
TF	Pilot	240A		0-100	10	8.000		91.3	WERL
TF	Full	1B		0-100	6	1.000		98.2	WERL
WOx	Bench	Zimpro		10000000	1	20000.000		99.8	WAO
WOx [B]	Bench	1054E		100000-1000000		27000.000		97.3	WERL
WOx [B]	Bench	1101D		>1000000		3600.000		99.92	WERL
WOx [B]	Bench	236A		>1000000	1	3000.000		99.97	WERL

* Data used in developing proposed standard.

TABLE 4-109B
INDUSTRY-SUBMITTED LEACHATE TREATMENT PERFORMANCE DATA FOR PHENOL

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
BT		DOW	10	715-2500	3	10.000		99.32	LEACHATE

Silvex. Limited data were available for silvex from one NPDES facility. These data are presented in Table 4-155. Due to a lack of information on this facility (i.e., influent concentration, technology basis) these data were not used to set BDAT. Treatment performance data were therefore transferred to this constituent from a constituent judged to be similar in elemental composition and functional groups within the structure of the chemical. For constituents represented by a U or P code, this means that constituents included in the same waste treatability group (see Appendix B) were candidates for transfer of data. Silvex is similar in structure to constituents in treatability group III.A.2.c.(3)(c) and the constituent used to transfer treatment performance data from was 2,4-dichlorophenoxyacetic acid. The treatment performance data for 2,4-dichlorophenoxyacetic acid are presented in Table 4-154. Using a transfer from this constituent results in a BDAT for silvex of chlorination (ChOx(Cl)) and a BDAT treatment standard of 0.72 ppm as described in Section 6.0 and shown in Table 6-10.

TABLE 4-155
WASTEWATER TREATMENT PERFORMANCE DATA
FOR SILVEX

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		MI0000868			9	3.778			NPDES

Toxaphene (P123). The data available for toxaphene were compiled from the NPDES database and are presented in Table 4-153. The technology for which data were available was full-scale BT. Resulting effluent concentrations ranged from 0.05 ppb to 1,004 ppb with a detection limit for toxaphene established a 0.24 ppb (see Table C-1, Appendix C).

BDAT for toxaphene is being promulgated as proposed and is identified as biological treatment (BT). Biological treatment was selected as BDAT since it represents full-scale data and is the only demonstrated technology for which the Agency has data. The BDAT treatment standard for toxaphene was calculated using an effluent concentration of 0.6781 ppb (which represents the average of all BT effluent values; a value below the detection limit was set at the detection limit) and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for toxaphene (0.0095 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-153
WASTEWATER TREATMENT PERFORMANCE DATA
FOR TOXAPHENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		OH0058874			5	0.2000			NPDES
		GA0003735			1	2.2000			NPDES
		CA0107611			1	0.1000			NPDES
		CA0048194			5	1.2520			NPDES
		CA0037681			13	0.5000			NPDES
		LA0058882			33	15.9000			NPDES
		CA0048216			5	1004.0000			NPDES
		LA0058882			32	15.6000			NPDES
		LA0065501			6	1.0000			NPDES
		MS0027995			8	444.0000			NPDES
		CA0107417			5	0.1001			NPDES
		GA0003735			39	1.3000			NPDES
		CA0037681			29	0.4000			NPDES
		CA0038598			5	0.7400			NPDES
* BT	Full	CA0047881			1	2.0000			NPDES *
* BT	Full	CA0108031			1	0.1000			NPDES *
* BT	Full	CA0048143			2	0.4500			NPDES *
* BT	Full	CA0047996			1	0.0500			NPDES *
* BT	Full	CA0110604			9	0.0900			NPDES *
* BT	Full	CA0047364			3	0.3667			NPDES *
* BT	Full	CA0037737			4	0.1325			NPDES *
* BT	Full	CA0037494			2	0.2625			NPDES *
* BT	Full	CA0022756			1	1.0000			NPDES *
* BT	Full	LA0038245			38	1.7421			NPDES *

* Data used in developing proposed standard.

1,2,4,5-Tetrachlorobenzene (U207). The data available for 1,2,4,5-tetrachlorobenzene were compiled from the NPDES database and are presented in Table 4-113. Since influent values were not available for the NPDES data and since the NPDES average effluent value was below the compound detection limit of 1.5 ppb it cannot be determined that this data represents treatment. Treatment performance data were therefore transferred to this constituent from a constituent judged to be similar in elemental composition and functional groups within the structure of the chemical. For constituents represented by a U or P code, this means that constituents included in the same waste treatability group (see Appendix B) were candidates for transfer of data. 1,2,4,5-Tetrachlorobenzene is in treatability group III.A.2.c.(3)(b) and the constituent used to transfer treatment performance data from was hexachlorobenzene. The treatment performance data for hexachlorobenzene is presented in Table 4-94. Using a transfer from this constituent results in a BDAT for 1,2,4,5-tetrachlorobenzene of activated sludge followed by filtration and a BDAT treatment standard of 0.055 ppm as described in Section 6.0 and shown in Table 6-10.

TABLE 4-113
WASTEWATER TREATMENT PERFORMANCE DATA
FOR 1,2,4,5-TETRACHLOROBENZENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		MI0000868			9	1.111			NPDES

1.2.4-Tricholorobenzene. The data available for 1,2,4-trichlorobenzene were compiled from the WERL database and are presented in Table 4-115. Technologies for which data are available include AFF, AS, BGAC, GAC, PACT^{R}, RO, and TF. The treatment performance data represent bench-, pilot-, and full-scale studies. The resulting effluent concentrations ranged from 0.02 ppb to 89 ppb.

BDAT for 1,2,4-trichlorobenzene is being promulgated as proposed and is identified as PACT^{R}. PACT^{R} was selected as BDAT since this technology represents full-scale treatment with a high influent concentration and a high removal efficiency. The BDAT treatment standard for 1,2,4-trichlorobenzene was calculated using the effluent concentration of 10 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for 1,2,4-trichlorobenzene (0.055 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-115
WASTEWATER TREATMENT PERFORMANCE DATA
FOR 1,2,4-TRICHLOROBENZENE

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
AFF	Bench	501A		0-100	23	0.870		90.5	WERL
AS	Full	6B		100-1000	330	71.000		88	WERL
AS	Pilot	241B		100-1000	9	89.000		86	WERL
AS	Full	1B		0-100	6	8.000		92	WERL
AS	Full	201B		0-100	13	14.000		80	WERL
AS	Full	1B		1000-10000	4	89.000		91.9	WERL
AS	Full	975B		100-1000		36.000		84	WERL
AS	Bench	200B		100-1000	14	12.000		90	WERL
BGAC	Bench	501A		0-100	34	0.280		96.9	WERL
GAC	Full	245B		1000-10000	1	10.000		99.74	WERL
GAC	Full	1421D		0-100		0.830		90	WERL
PACT	Bench	200B		100-1000	12	2.100		98	WERL
* PACT	Full	6B		100-1000	10	10.000		96	WERL *
RO	Pilot	180A		0-100		0.020		95.7	WERL
TF	Full	1B		0-100	3	5.000		91.7	WERL

* Data used in developing proposed standard.

2,4,5-Trichlorophenol. The data available for 2,4,5-trichlorophenol were compiled from the NPDES database and are presented in Table 4-116A. In addition, leachate treatment performance data submitted by industry just prior to proposal are presented in Table 4-116B. The demonstrated treatment technology presented was BT.

At proposal, BDAT for 2,4,5-trichlorophenol was identified as activated sludge (AS) and the treatment standard was based on an effluent concentration of 1 ppb from a transfer of 2,4,6-trichlorophenol treatment performance data. Between proposal and promulgation, EPA evaluated the industry-submitted leachate data available for 2,4,5-trichlorophenol. Since this data for biological treatment (BT) showed substantial treatment of 2,4,5-trichlorophenol and showed average leachate effluent values greater than that of activated sludge, these data were used to calculate the promulgated standard. In addition, the Agency preferred to set the BDAT treatment standard on actual data rather than on a transfer of treatment performance data. Therefore, BDAT for 2,4,5-trichlorophenol is biological treatment.

The BDAT treatment standard for 2,4,5-trichlorophenol was calculated using the effluent concentration of 50 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for 2,4,5-trichlorophenol (0.18 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-116A
WASTEWATER TREATMENT PERFORMANCE DATA FOR 2,4,5-TRICHLOROPHENOL

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
Gr/Rem	Full	WI0029149			4	8.000			NPDES

TABLE 4-116B
INDUSTRY-SUBMITTED TREATMENT PERFORMANCE DATA FOR 2,4,5-TRICHLOROPHENOL

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
BT		DOW	50	25-1000	3	50.000		90.1	LEACHATE

2,4,6-Trichlorophenol. The data available for 2,4,6-trichlorophenol were compiled from the NPDES and WERL databases and are presented in Table 4-117A. In addition, leachate treatment performance data submitted by industry just prior to proposal are presented in Table 4-117B. Technologies for which data are available include AS, BT, and RO. The treatment performance data represent pilot- and full-scale studies. The resulting effluent concentrations ranged from 0.01 ppb to 7,150 ppb.

At proposal, BDAT for 2,4,6-trichlorophenol was identified as activated sludge (AS) and the treatment standard was based on an effluent concentration of 1 ppb. Between proposal and promulgation, EPA evaluated the industry-submitted leachate data available for 2,4,6-trichlorophenol. Since this data for biological treatment (BT) showed substantial treatment of 2,4,6-trichlorophenol and showed average leachate effluent values greater than those of activated sludge, these data were used to calculate the promulgated standard. Therefore, BDAT for 2,4,6-trichlorophenol is biological treatment.

The BDAT treatment standard for 2,4,6-trichlorophenol was calculated using the effluent concentration of 10 ppb and the appropriate variability factor and accuracy correction factor. The calculation of the resulting BDAT treatment standard for 2,4,6-trichlorophenol (0.035 ppm) is described in Section 6.0 and is shown in Table 6-10.

TABLE 4-117A
WASTEWATER TREATMENT PERFORMANCE DATA FOR 2,4,6-TRICHLOROPHENOL

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
		PA0033367			1	10.000			NPDES
		PA0036650			6	5.170			NPDES
		AR0038512			25	3083.510			NPDES
		PA0008231			7	7150.000			NPDES
		LA0065501			6	10.000			NPDES
		AR0038512			20	1294.810			NPDES
		CT0001341			30	398.000			NPDES
		MI0000868			8	2.000			NPDES
		PA0008231			1	10.000			NPDES
		LA0066214			15	10.000			NPDES
		NJ0005134			18	37.647			NPDES
* AS	Full	375E		0-100	7	0.070		42	WERL *
* AS	Full	375E		0-100	7	0.040		60	WERL *
BT	Full	PA0026247			25	11.520			NPDES
BT	Full	LA0038245			38	10.466			NPDES
BT	Full	NY0026042			3	5.000			NPDES
BT	Full	MI0022276			22	0.635			NPDES
RO	Pilot	180A		0-100		0.010		98	WERL

* Data used in developing proposed standard.

TABLE 4-117B
INDUSTRY-SUBMITTED TREATMENT PERFORMANCE DATA FOR 2,4,6-TRICHLOROPHENOL

TECHNOLOGY	TECHNOLOGY SIZE	FACILITY	DETECTION LIMIT (ppb)	RANGE INFLUENT CONCENTRATION (ppb)	NO. OF DATA POINTS	AVERAGE EFFLUENT CONCENTRATION (ppb)	RECOVERY (%)	REMOVAL (%)	REFERENCE
BT		DOW	10	26-200	3	10.000		90.49	LEACHATE

APPENDIX C

SUMMARY OF PLANT CODES

Table C-1

PLANT CODE REFERENCE LIST

Plant (Test Number)	Facility/Location	Reference Number(s)
1	U.S. EPA Combustion Research Facility, Jefferson, AR	10
2	U.S. EPA Combustion Research Facility, Jefferson, AR	11
3	John Zink Test Facility, Tulsa, OK	12
4	Rollins Environmental Services (TX) Inc., Deer Park, TX	13
5	U.S. EPA Combustion Research Facility, Jefferson, AR	14
6	U.S. EPA Combustion Research Facility, Jefferson, AR	15
7	Amoco Oil Company, Whiting, IN	16, 17
8	U.S. EPA Combustion Research Facility, Jefferson, AR	18
9	John Zink Test Facility, Tulsa, OK	19
10	John Zink Test Facility, Tulsa, OK	20
11	ENSCO, El Dorado, AR	21
12	John Zink Test Facility, Tulsa, OK	22
13	John Zink Test Facility, Tulsa, OK	9
14	John Zink Test Facility, Tulsa, OK	9

APPENDIX D

ACCURACY CORRECTION OF TREATMENT PERFORMANCE DATA

APPENDIX D

ACCURACY CORRECTION OF TREATMENT PERFORMANCE DATA

D.1 K Wastes

The treatment performance data used to determine treatment standards for the K-pesticide wastes were adjusted to account for analytical interferences associated with the chemical matrices of the samples. Generally, treatment performance data were corrected for accuracy as follows: (1) a matrix spike recovery was determined for each BDAT List constituent detected in the untreated or treated waste; (2) an accuracy correction factor was determined for each of the above constituents by dividing 100 by the matrix spike recovery (percent) for that constituent; and (3) treatment performance data for each BDAT List constituent detected in the untreated or treated waste were corrected by multiplying the reported concentration of each constituent by its corresponding accuracy correction factor. The procedure for accuracy correction of the data is described in further detail below.

Matrix spike recoveries are developed by analyzing a sample of a treated waste for a constituent and then re-analyzing the sample after the addition of a known amount of the same constituent (i.e., spike) to the sample. The matrix spike recovery represents the total amount of constituent recovered after spiking, minus the initial concentration of the constituent in the sample, and the result divided by the spike concentration of the constituent.

Matrix spike recoveries used to adjust the treatment performance data for pesticide wastes are shown in Table D-1. (All tables are presented at the end of this section.) Duplicate matrix spikes were performed for some BDAT List constituents. If a duplicate matrix spike was performed for a constituent, the matrix spike recovery used for that constituent was the lower of the two values from the first matrix spike and the duplicate spike.

Where a matrix spike was not performed for an organic constituent, the matrix spike recovery for that constituent was derived from the average matrix spike recoveries of the appropriate group of constituents (e.g., volatile or semivolatile organics) for which recovery data were available. In these cases, the matrix spike recoveries for all volatiles or semivolatiles from the first matrix spike were averaged. Similarly, an average matrix spike recovery was calculated for the duplicate matrix spike recoveries. The lower of the two average matrix spike recoveries of the volatile or semivolatile group was used for any volatile or semivolatile constituent for which no matrix spike was performed.

An accuracy correction factor of 1.00 was used when both the matrix spike and duplicate matrix spike recoveries exceeded 100%, so that the data were not adjusted to concentrations below the detection limits. Matrix spike values of less than 20% are not acceptable and were not used to correct detection limits, nor were they included in average value calculations.

The accuracy correction factors for the data used to calculate treatment standards for pesticide wastes are presented in Table D-2. The uncorrected detection limits used for constituents selected for regulation are presented in Table D-3. The corrected treatment concentrations used to calculate treatment standards are presented in Table D-4.

D.2 D Wastes

As described in Section 6.1, matrix spike recoveries were used to correct detection limits to account for analytical interferences associated with the chemical matrices of the samples. For nonwastewater forms of the D wastes, in cases where a matrix spike was not performed for a waste constituent in the treatment test from which the detection limit was transferred, the matrix spike recovery for a similar constituent in that treatment test was transferred to that constituent. An accuracy correction factor was determined for each constituent by dividing 100 by the matrix spike recovery (expressed as a percent) for that constituent.

Table D-5 presents the matrix spike recoveries obtained in each of the 14 incineration tests. Matrix spike recoveries and accuracy correction factors used for each constituent are included in Tables 6-1 through 6-5 in Section 6.0.

Table D-1

MATRIX SPIKE RECOVERIES IN KILN ASH FROM TEST 13

Spike Constituent	Original Amount Found[a] (ppm)	Sample Result			Duplicate Sample Result		
		Amount Spiked (ppm)	Amount Recovered (ppm)	Percent Recovery[b] (%)	Amount Spiked (ppm)	Amount Recovered (ppm)	Percent Recovery[b] (%)
SEMIVOLATILE ORGANICS[c]							
52. Acenaphthene	ND	3.240	1.640	51	3.270	0.784	24
70. Bis(2-ethylhexyl)-phthalate	ND	0.200	0.172	86	0.200	0.156	78
73. 2-sec-Butyl-4,6-nitrophenol	ND	0.200	0.129	65	0.200	0.025	13
76. p-Chloro-m-cresol	ND	6.490	5.440	84	6.540	5.740	88
78. 2-Chlorophenol	ND	6.490	3.150	49	6.540	2.740	42
88. 1,4-Dichlorobenzene	ND	3.240	0.842	26	3.270	0.759	23
102. 2,4-Dinitrotoluene	ND	3.240	2.370	73	3.270	1.820	56
105. N-Nitroso-di-n-propylamine	ND	3.240	1.890	58	3.270	1.640	50
110. Hexachlorobenzene	ND	0.100	0.054	54	0.100	0.021	21
117. Isosafrole	ND	0.100	0.034	34	0.100	0.028	28
127. 4-Nitrophenol	ND	6.490	5.900	91	6.540	3.140	48
139. Pentachlorophenol	ND	6.490	4.820	74	6.540	ND	0
142. Phenol	ND	6.490	4.540	70	6.540	3.990	61
144. Pronamide	ND	0.100	0.099	99	0.100	0.069	69
145. Pyrene	ND	3.240	1.600	49	3.270	ND	0
150. 1,2,4-Trichlorobenzene	ND	3.240	0.965	30	3.270	0.828	25
ORGANOCHLORINE PESTICIDES[d]							
186. Heptachlor	ND	0.06462	0.03490	54	0.06545	0.01836	28
190. Methoxychlor	ND	0.06462	0.01026	16	0	0	200

ND - Not detected.

[a] For constituents not detected above the detection limit (ND), the original amount found is considered as zero in calculating percent recovery.

[b] Percent recovery = 100 x $((C_i - C_o)/C_t)$, where C_o is the concentration of the original amount found, C_i is the concentration of the amount recovered, and C_t is the concentration of the amount spiked.

[c] The averages of the base/neutral semivolatile organic matrix spike and duplicate spike recoveries were 56.2% and 38.4%, respectively.

[d] The averages of the organochlorine pesticides matrix spike and duplicate spike recoveries were 54% and 28%, respectively.

Table D-2

SUMMARY OF ACCURACY CORRECTION FACTORS USED IN TREATMENT STANDARD CALCULATIONS FOR PESTICIDE K WASTES

BDAT List Constituent	Kiln Ash[a]
Semivolatile Organics	
110. Hexachlorobenzene	4.76
112. Hexachlorocyclopentadiene	2.60
Organochlorine Pesticides	
177. Chlordane	3.57
186. Heptachlor	3.57
190. Methoxychlor	5.00

[a] The accuracy correction factor is equal to 100 divided by the lowest matrix spike percent recovery.

Table D-3

UNCORRECTED DETECTION LIMITS FROM TEST 13

BDAT List Constituent	Detection Limit in Treatment Residuals (ppm) Sample Set 1	Sample Set 2	Sample Set 3	Sample Set 4
NONWASTEWATERS				
Semivolatile Organics:				
110. Hexachlorobenzene	0.33	0.36	0.31	0.33
112. Hexachlorocyclopentadiene	0.33	0.36	0.31	0.33
Organochlorine Pesticides:				
177. Chlordane	0.013	0.013	0.013	0.013
186. Heptachlor	0.0066	0.0066	0.0066	0.0066
190. Methoxychlor	0.013	0.013	0.013	0.013

Table D-4

ACCURACY CORRECTED DATA USED TO CALCULATE TREATMENT STANDARDS FOR PESTICIDE K-WASTES

BDAT List Constituent	Corrected Total Concentration in Treatment Residuals (ppm) Sample Set 1	Sample Set 2	Sample Set 3	Sample Set 4
NONWASTEWATERS				
Semivolatile Organics:				
110. Hexachlorobenzene	1.57	1.71	1.48	1.57
112. Hexachlorocyclopentadiene	0.858	0.936	0.806	0.858
Organochlorine Pesticides:				
177. Chlordane[1]	0.0464	0.0464	0.0464	0.0464
186. Heptachlor	0.0236	0.0236	0.0236	0.0236
190. Methoxychlor[2]	0.0464	0.0464	0.0464	0.0464

[1] To account for both the alpha and gamma isomers of chlordane, the corrected total concentration in the treatment residual was doubled to calculate the treatment standard for chlordane. Treatment standards for toxaphene are based on the transfer of performance data for chlordane. Because the detection limits for toxaphene are typically ten times greater than those of chlordane, the corrected chlordane concentration was then multiplied by ten to calculate the treatment standard for toxaphene.

[2] Treatment standards for PCBs are based on the transfer of performance data for methoxychlor. Because the detection limits for Aroclors 1016, 1221, 1232, 1242, and 1248 are typically five times greater than those of methoxychlor, the corrected methoxychlor concentration was multiplied by five to calculate the treatment standards for these five PCBs. Similarly, the detection limits for Aroclors 1254 and 1260 are typically ten times greater than those of methoxychlor, and so, the corrected methoxychlor concentration was multiplied by ten to calculate the treatment standards for these two PCBs.

TABLE D-5

MATRIX SPIKE PERCENT RECOVERIES IN ASH FROM FOURTEEN INCINERATION TESTS *

BDAT No. Constituent	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10	Test 11	Test 13	Test 14
Volatile Organics:													
1 Acetonitrile			79,80										
2 Acrolein			80,47										
3 Acrylonitrile			110,108										
4 Benzene	88,88	78,88	141,146	90,85	104,104	104,104,88,94	88	100,98	102,106	104,108	126,130	117,156	103,97
9 Chlorobenzene	124,120	102,112	107,107	99,100	112,112	108,108,114,120	46	106,106	104,110	106,110	90,108	92,56	115,109
22 1,1-Dichloroethane								114,114	100,96	126,130			
24 1,1-Dichloroethylene		86,95	99,104	85,78	140,136	68,68,58,66	96	114,114	100,96	126,130	80,122	35,32	75,73
229 Methyl isobutyl ketone												88,117	48,43
38 Methylene Chloride												300,309	120,124
43 Toluene	108,108	99,110	113,117		122,107	124,84,166,165	80	106,104	106,116	112,114	170,222	243,153	109,93
45 1,1,1-Trichloroethane												539,866	109,110
47 Trichloroethene	88,84	67,77	104,105	107,112	104,108	84,84,80,80	76	114,114	116,126	112,116	178,216	210,294	109,103
215-217 Total Xylenes												61,23	92,91
Semivolatile Organics:													
51 Acenaphthalene									41,39	73,74			
52 Acenaphthene	120,120	0,3.4		110,110	96,96	103,100	66,63	93,91			30,88	51,24	60,54
70 Bis(2-ethylhexyl)phthalate												86,78	78,71
73 2-sec-Butyl-4,6-dinitrophenol		113,88										65,13	41,41
76 p-Chloro-m-cresol	90,95	35,68		110,120	88,86	88,88	56,57	92,87	47,44	66,64	98,135	88,84	90,79
78 2-Chlorophenol	100,105	59,53		98,100	107,109	75,75	70,70	78,83	41,39	62,58	78,102	49,42	53,41
87 p-Dichlorobenzene							75,76						
88 o-Dichlorobenzene	94,94	48,46		90,99	89,90	74,74		79,89	40,39	75,70	72,90	26,23	29,17
102 2,4-Dinitrotoluene	120,120	0,0		107,110	118,118	109,112	54,52	121,109	48,47	58,58	38,100	73,56	71,63
105 Di-n-propylnitrosamine	81,82	67,62		120,130	40,26	62,56	70,70	82,84	46,45	64,61	110,118	58,50	53,46
110 Hexachlorobenzene												54,21	74,139
117 Isosafrole												34,28	44,39
127 4-Nitrophenol	100,90	1.2,2.6		97,110	120,114	100,86	32,31	37,35	33,32	22,21	50,90	91,48	77,64
139 Pentachlorophenol	95,105	0,0		88,88	98,91	48,33	34,34	7,11	30,25	38,35	27,64	74,0	77,69
142 Phenol	85,80	72,65		90,97	96,94	70,67	65,65	77,80	41,40	65,61	101,122	70,61	70,60
144 Pronamide												99,69	92,84
145 Pyrene	96,100	0,0		120,92	94,82	47,26	58,53	34,39	46,45	85,79	6,82	49,0	73,66
150 1,2,4-Trichlorobenzene	95,100	30,30		75,80	90,90	85,88	90,86	84,89	41,39	75,76	60,90	30,25	36,24
Organochlorine Pesticides:													
176 gamma-BHC		62,75				64,56							
181 Dieldrin						50,39							
186 Heptachlor												54,28	88,93
187 Heptachlor epoxide		75,88				72,56							
190 Methoxychlor		118,145				36,38						16,0	0,42
Phenoxyacetic Acid Herbicides:													
192 2,4-Dichlorophenoxyacetic acid		42,69				55,39						0,0	0,0
193 Silvex						64,45						0,0	0,0
194 2,4,5-T						39,27						0,0	0,0

* No matrix spike recovery data were collected in the ash from incineration test 12.

APPENDIX E

VARIABILITY FACTOR CALCULATIONS

APPENDIX E

VARIABILITY FACTOR CALCULATIONS

As noted in Section 6.1, the variability factor accounts for the variability inherent in treatment system performance, treatment residual collection, and treatment sample analysis. For more information on the calculation of variability factors, see EPA's Methodology for Developing BDAT Treatment Standards (Reference 2).

A variability factor was calculated for a constituent when the test from which the detection limit was transferred contained the constituent at concentrations above the detection limit in the ash residual. This occurred with one constituent, 2,4-D, and is reflected in the treatment standard calculation for D016 nonwastewaters summarized in Table 6-3. The calculation of a variability factor for 2,4-D nonwastewaters is shown in Table E-1.

Table E-1

VARIABILITY FACTOR CALCULATION

D016 NONWASTEWATERS

INPUT DATA:

Constituent: 2,4-D
BDAT Number: 192
Accuracy Correction Factor: 5.00

Sample Set	Unadjusted Value (ppm)	A or DL	Adjusted Value (ppm)	ln of Adjusted Values
1	0.021	A	0.03045	-3.49166
2	0.2	DL	0.29	-1.23787
3	0.2	DL	0.29	-1.23787
4	0.2	DL	0.29	-1.23787

RESULTS:

Mean of Adjusted Values = 0.2251
Mean of lns = -1.8013
Standard Deviation of lns = 1.1269
C99 = 2.2804
VF = 10.1300

A - Actual value detected in treatment residual.
DL - Detection limit (given if undetected in treatment residual).